Dräger medical
A Dräger and Siemens Company

Technical Documentation

Zeus
Anesthetic workstation

Revision 3.0
5133.001
9036190

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General

1 Symbols and Definitions

WARNING

A WARNING statement provides important information about a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

A CAUTION statement provides important information about a potentially hazardous situation which, if not avoided, may result in minor or moderate injury to the user or patient or in damage to the equipment or other property.

NOTE

A NOTE provides additional information intended to avoid inconvenience during operation.

Definitions according to German standard DIN 31051:

Inspection	=	examination of actual condition
Maintenance	=	measures to maintain specified condition
Repair	=	measures to restore specified condition
Servicing	=	inspection, maintenance, and repair

2 Notes

This Technical Documentation conforms to the IEC 60601-1 standard.

Read each step in every procedure thoroughly before beginning any test. Always use the proper tools and specified test equipment. If you deviate from the instructions and/or recommendations in this Technical Documentation, the equipment may operate improperly or unsafely, or the equipment could be damaged.

It is our recommendation to use only Dräger parts and supplies.

The maintenance procedures described in this Technical Documentation may be performed by qualified service personnel only. These maintenance procedures do not replace inspections and servicing by the manufacturer.

The information in this Technical Documentation is confidential and may not be disclosed to third parties without the prior written consent of the manufacturer.

This Technical Documentation is for the purpose of information only. Product descriptions found in this Technical Documentation are in no way a substitute for reading and studying the Instructions for Use/Operating Manual enclosed with the product at the time of delivery.

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3 Abbreviations and Definitions

A-Box	Anaesthetic Gas Box
APL	Adjustable Pressure Limit
CAN	Controller Area Network
CPCI	Compact Peripheral Component Interconnect
DAGMAR	Digital Advanced Gas Mixer for Anesthesia Requirements
DIANA	DIgita ANaesthestic controller in A-Box
DIVA	Digital Injection of Volatile Agent
DUMA	Flowmeter for volatile anaesthetic
DVI	Digital Video Interface
EEPROM	Electrically Eraseable Programmable Read Only Memory
Flash-ROM	Flash Read Only Memory
GMZ	Gas Measuring module Zeus
HERMES	Display and operating unit of Zeus
ILCA	Infrared Low Cost Analyzer
IRIA	Infrared Rapidly Identifying Analyzer
MIB	Management Information Base
MIR	Mid Infrared Range
MISO	Master Input Slave Output
MOSI	Master Output Slave Input
NIR	Near Infrared Range
PLD	Programmable Logic Device
PWM	Pulse Width Modulation
RAM	Random Access Memory
SDRAM	Synchronous Dynamic RAM
SNMP	Simple Network Management Protocol
SPI	Serial Peripheral Interface
SRAM	Static RAM
TFT	Thin Film Transistor
TIVA	Total IntraVenous Anesthesia
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
UPS	Uninterruptible Power Supply
Zeus	Name of anaesthetic workstation

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Function Description

1 General information about Zeus

Figure 1 View of the Zeus anesthesia workstation

1.1 Intended use (summary from the Instructions for Use manual)

Zeus is an integrated anesthesia workstation for inhalation and intravenous anesthesia. Zeus is used

- in operating rooms as well as in induction and recovery rooms
- in adults, children and neonates
- with anesthetic agents Isoflurane, Sevoflurane and Desflurane
- with gas mixtures O2/AIR, O2/N2O
- in partial rebreathing to complete rebreathing mode
- for operation with external fresh-gas outlet - non-rebreathing systems
- for inhalation anesthesia, balanced and intravenous anesthesia

1.2 Product classification

Class II b according to the Directive 93/42 EEC, Annex IX.

1.3 Protection classes

Class I according to EN 60601-1.

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1.4 Brief description of the system

The integrated anesthetic workstation Zeus includes the following components:

- Windows NT computer with system display unit for operation of therapy control and monitoring
- electronic gas and anesthetic agent flow control with closed-loop control system
- electronically controlled and driven blower with rebreathing system
- airway monitoring
- hemodynamics monitoring module

The following extensions are available as optional features:

- Dräger syringe pumps for intravenous anesthesia

1.4.1 Configuration

The Zeus anesthesia workstation can be subdivided into the display and control unit HERMES and the anesthetic gas box (A-Box).

HERMES is a PC based system for display and control of the A-Box or other connected front-end units, such as the parameter box for measurement of hemodynamic values. In addition, HERMES provides all external interfaces of the Zeus anesthesia workstation, e.g. printer and serial ports.

The anesthetic gas box (Figure 2) contains the actuators required for the system, the mixed-gas flow control, the anesthetic-agent flow-control, the breathing system, the lung ventilator and the monitoring system. The anesthetic gas box also comprises slots and interfaces for future optional features.

1.4.2 The most important external characteristics

The anesthetic workstation Zeus has an excellent ergonomic design. This includes, for example:

- A system display unit mounted on a hinged arm that allows a 180° rotation. A second flat display (optional feature) can be arranged on top of the system display unit.
- A housing shape that is suitable both for left-hand/right-hand operation. This includes, besides the rotatable system display unit, a push-through work top and a push-through drawer. The absorber can be viewed easily from both sides.
- Concealed, left-hand and right-hand rails for mounting of accessories.
- O2 flush buttons that can be operated on left-hand side and right-hand side.
- A central locking brake for trolley castors that can be operated from both sides.

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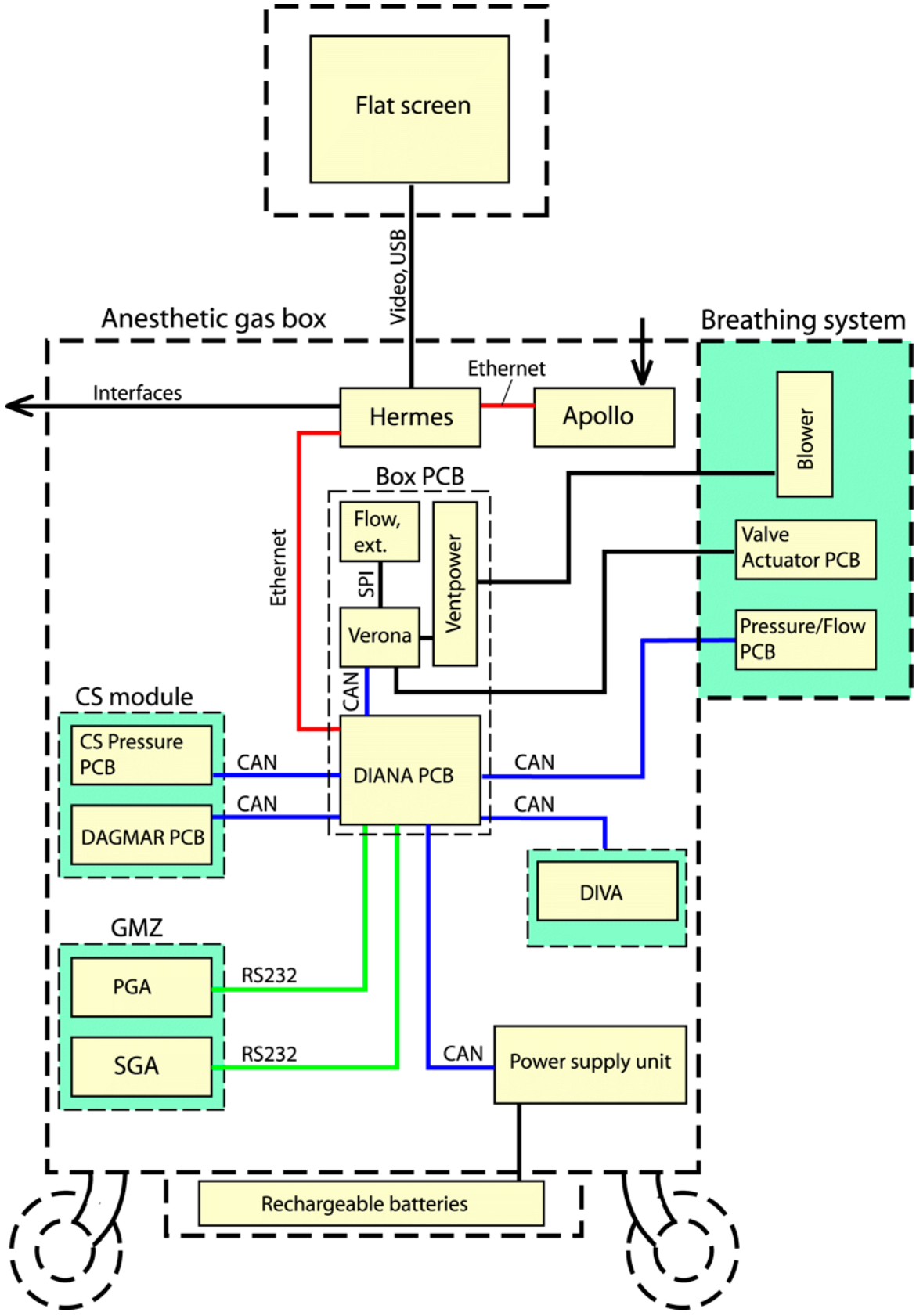

Figure 2 System overview

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2 Anaesthetic Gas Box

2.1 General introduction

The anaesthetic gas box comprises the trolley and the housing of the Zeus. Apart from the monitor, it includes all the components required to operate the functions of the Zeus. They include:

- Power supply unit
- Hermes computer
- PCB box
- CS module (CS = Central Supply)
- DIVA (digital anaesthetic metering unit)
- GMZ (Zeus gas measuring module)
- Blower (ventilator)
- Breathing system

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3 PCB Box

The PCB box is a housing system for PCBs in the Zeus. It principally comprises the Transfer PCB, which performs the function of a motherboard. The Transfer PCB accommodates additional PCBs: the standard Zeus PCBs as well as PCBs for later options.

At present the PCB box holds the following PCBs:

– DIANA PCB
– VERONA PCB
– Vent Power PCB
– External Flow PCB

3.1 DIANA PCB

3.1.1 Purpose

The DIANA PCB handles the communication of all system processors with the HERMES via an Ethernet link. By way of the Transfer PCB the relevant signals of various modules and the 24 V supply are routed to the DIANA PCB. The internal 3.3 and 5 V operating voltages are generated on the DIANA PCB by means of DC/DC-converters.

3.1.2 Function

The central module of the DIANA PCB is the processor MPC 850 (Figure 3).

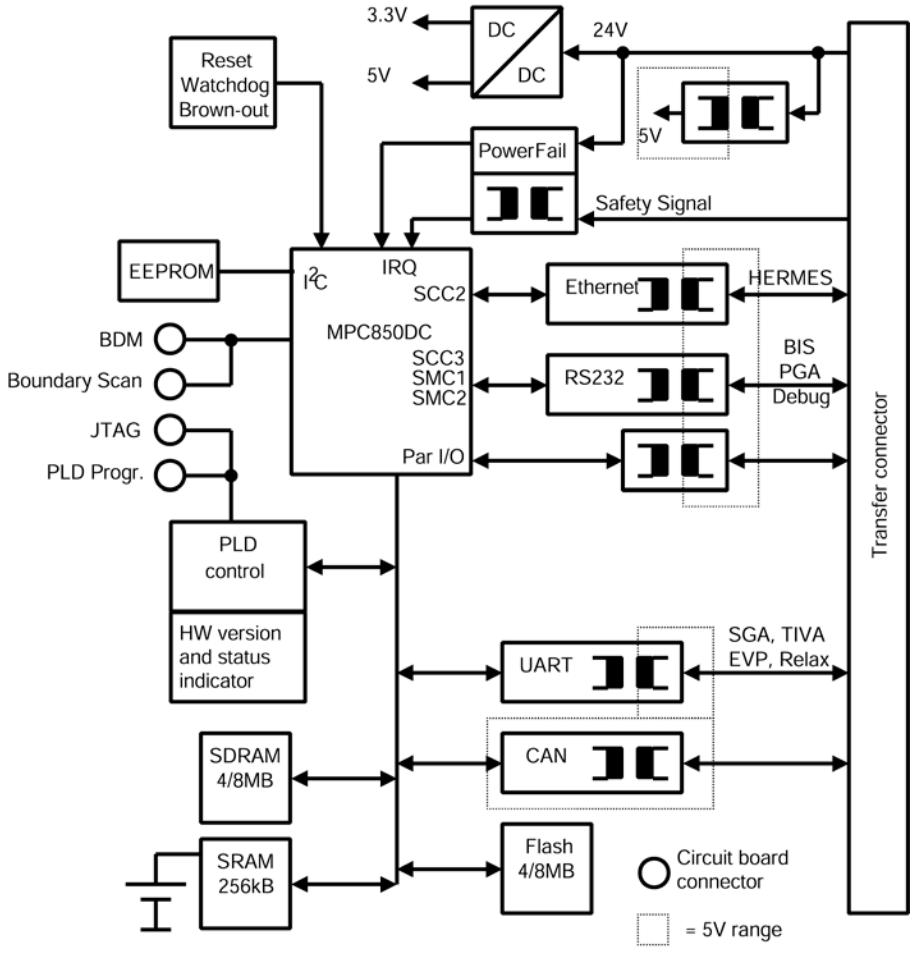

Figure 3 Block diagram of the DIANA PCB

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The operating program is located in a 4 or 8 MB Flash-ROM which is loaded into a 4 or 8 MB SDRAM as appropriate during start-up. Key software components can be stored in a 256 kB SRAM which is battery-buffered to protect against failure of the operating voltage. Key parameters can additionally be saved to an EEPROM via an I2C-port.

In addition to the memory modules, a CAN-controller and a four-way-UART are also connected to the system bus. The modules are selected by way of a PLD. The CAN-controller handles most of the communication with the other processors in the overall system with the aid of the installed SABUS-protocol. The four-way UART handles the communication with the ILCA module and with any subsequent add-ons. An Ethernet controller handles the communication with the HERMES system. The IRIA module and a serial port for Service are connected via an electrical isolator directly to the processor. The power supply unit generates a Power Fail signal indicating failure of its primary voltage (240 V mains voltage). The 24 V is also monitored in order to utilize time reserves prior to total failure of the supply voltage for regulation shutdown of the processor. An additional integrated module monitors the 3.3 V supply (Brown-Out monitor).

3.2 VERONA PCB

3.2.1 Purpose

The VERONA PCB is required in the ZEUS to control the ventilator and to interface to the CAN bus. For this, a microcontroller system based on the PPC555 is used.

3.2.2 Function

The circuit is operated with a 24 V supply (Figure 4).

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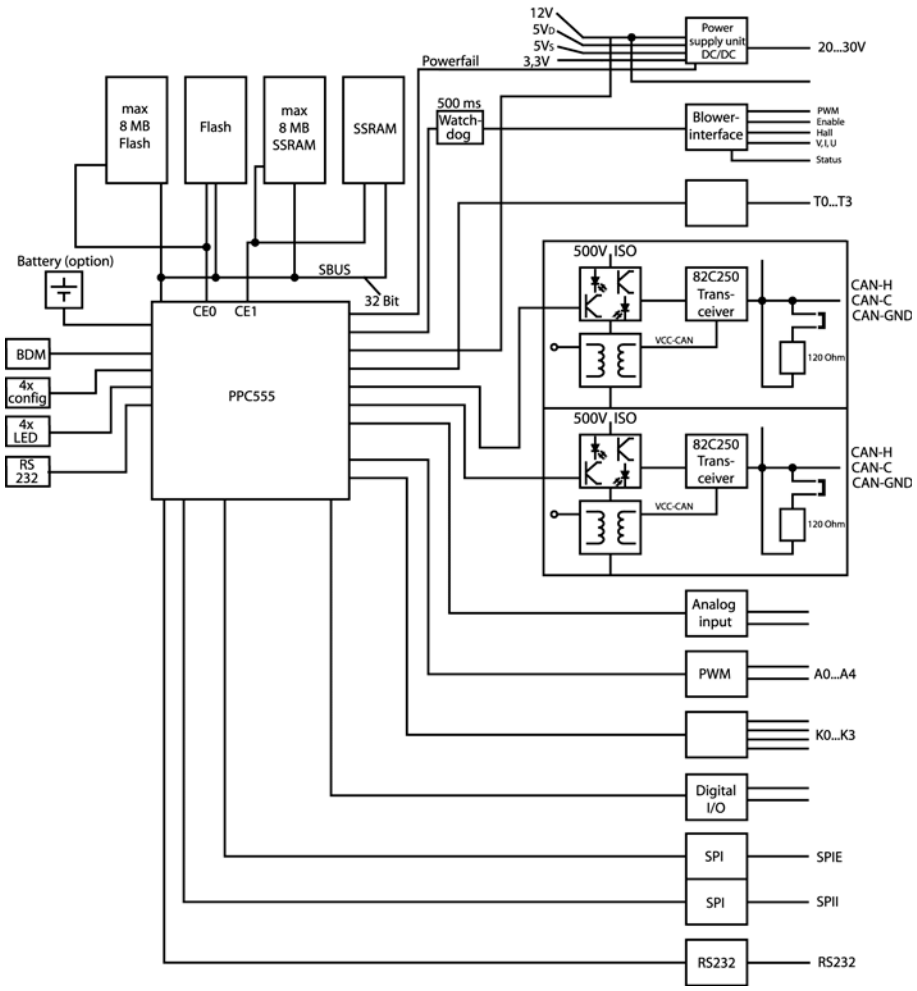

Figure 4 Block diagram of the VERONA PCB

The voltage supply is fed in via an EMC-filter and monitored by the controller. The controller PPC555 has an internal RAM which can be optionally battery-buffered. The following operating voltages are generated on the PCB:

– 3.3 V for microcontroller
– 5 V for temperature sensors
– 5 V for digital modules
– 12 V for pressure sensors

The processor system has two serial ports (max 115 kbaud). Two CAN-interfaces actively support the Full CAN V2.0A and V2.0B-protocol at up to 1Mb/s. The CAN-buses are each isolated from the rest of the system and from each other by an isolating voltage of at least 500 V AC. Optocouplers are used to isolate the signals. To activate the blower motor the board has a dedicated interface. The power electronics for the blower are located on the Vent Power PCB. For speed evaluation the three TTL-signals Hall-A, Hall-B and Hall-C

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are delivered by the motor electronics. The motor temperature is evaluated, as are the other temperature sensors. 6 LEDs are provided for output of status signals. The following LEDs are interesting for service work:

– 12 V supply voltage = LED V405
– 5 V supply voltage = LED V402

If only LED V302 of the 4 LEDs between the SUB-D connectors is lit the hardware is in test mode.

3.3 Vent Power PCB

3.3.1 Purpose

The Vent Power PCB contains the power electronics to activate the blower and the external valves. It provides the link between the valve control and the pneumatic system.

3.3.2 Function

The respective power stages can be disabled by an external signal (Figure 5).

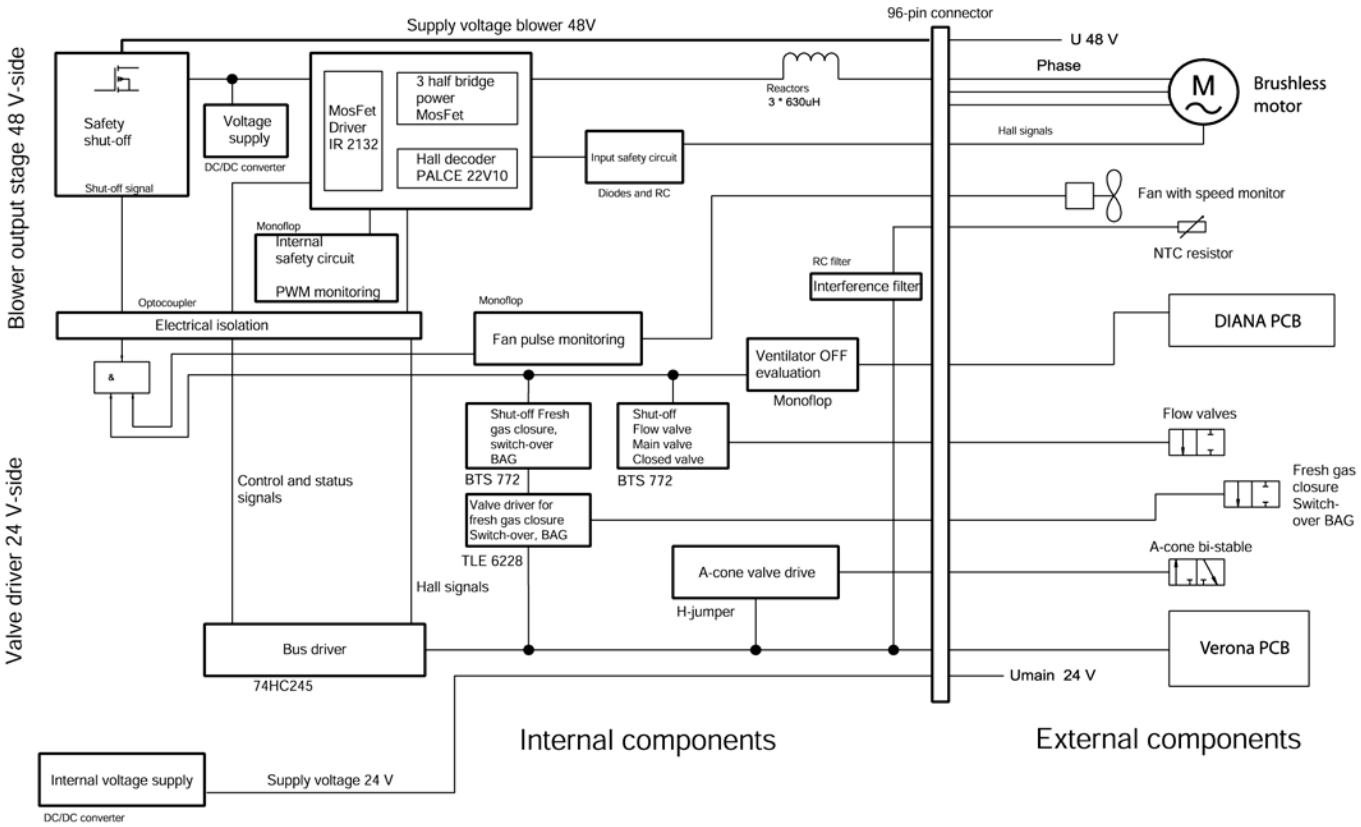

Figure 5 Vent Power PCB block diagram

This signal is generated by an independent monitoring computer. In addition to the power stages, the sender information from the TurboVent and the status signals of the various output stages are processed and passed on for evaluation to the TurboVent control computer. The supply voltage of the TurboVent is 48 V DC and that of the valves is normally 24 V. Because of the different supply voltages and the substantial peak currents in the TurboVent activation circuit these blocks are electrically isolated by optocoupler.

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The supply voltage for the TurboVent is externally stabilised in the power supply unit to 48 V and has a current limit of 3 A. An external 68000 uF capacitor is included to deal with the high peak currents of the motor.

The function of the blower power stage is to provide phase-adjusted activation of the motor coil with the aid of the Hall sensors built into the motor and to control the speed of the motor. The Hall signals are formatted by an inverter and passed to the Hall decoder. This module decodes the Hall signals of the motor and codes the activation signals of the MOSFET driver from them. The power MOSFETs are activated by a MOSFET driver. The output stage comprises 3 half-bridges each with two identical n-channel MOSFETs. At a TurboVent electronics supply voltage below 38 V a protective circuit disables the MOSFET activation. As the motor is run in a highly dynamic mode at high speeds, the power stage is rated for a peak power output of approximately 480 W. The mean load in operation is approximately 100 W.

The fan delivers one pulse per fan wheel revolution. This pulse is filtered by an RC element and routed to a retriggerable monoflop. If the pulses are not received, the monoflop drops out and disables the power electronics for the TurboVent. This ensures that the TurboVent is only activated when the fan is running. This prevents harmful overheating or excessive oxygen concentration build-up at the TurboVent motor.

The Vent Power PCB also contains the activation electronics for the valves in the breathing system and their interface to the TurboVent control computer. Additionally, the Ventilator-OFF signal is evaluated by the DIANA PCB to cut the power to the driver stages.

The A-cone valve is a single-turn bipolar valve. The turn must be activated in bipolar mode by a voltage pulse. This valve driver is independent of the Ventilator-OFF signal.

The power electronics for the flow valves are located directly at the pneumatic interface underneath the valves, and not on this PCB. However, the valves are shut off by the Ventilator-OFF signal by way of a HIGH-side FET switch on this module. The switch cuts the supply voltage to the flow valves.

The valves, seal, fresh gas, switch-over and BAG are controlled by a low-side MOSFET switch. This module has a monitoring output which is routed to the TurboVent control computer. The monitoring covers short-circuit and open load.

3.4 External Flow PCB

3.4.1 Purpose

The “Alveon” flow sensor is designed for adult patient-local directional flow measurement and is built into the patient Y-piece. The External Flow PCB digitises the sensor signals and supplies the data via SPI.

3.4.2 External Flow PCB function

The External Flow PCB circuitry is divided into 3 areas (Figure 6):

– Supply voltage with electrical isolation from the overall system
– Analog measurement processing
– Digital measurement processing with data interface and electrical isolation from VERONA PCB via SPI

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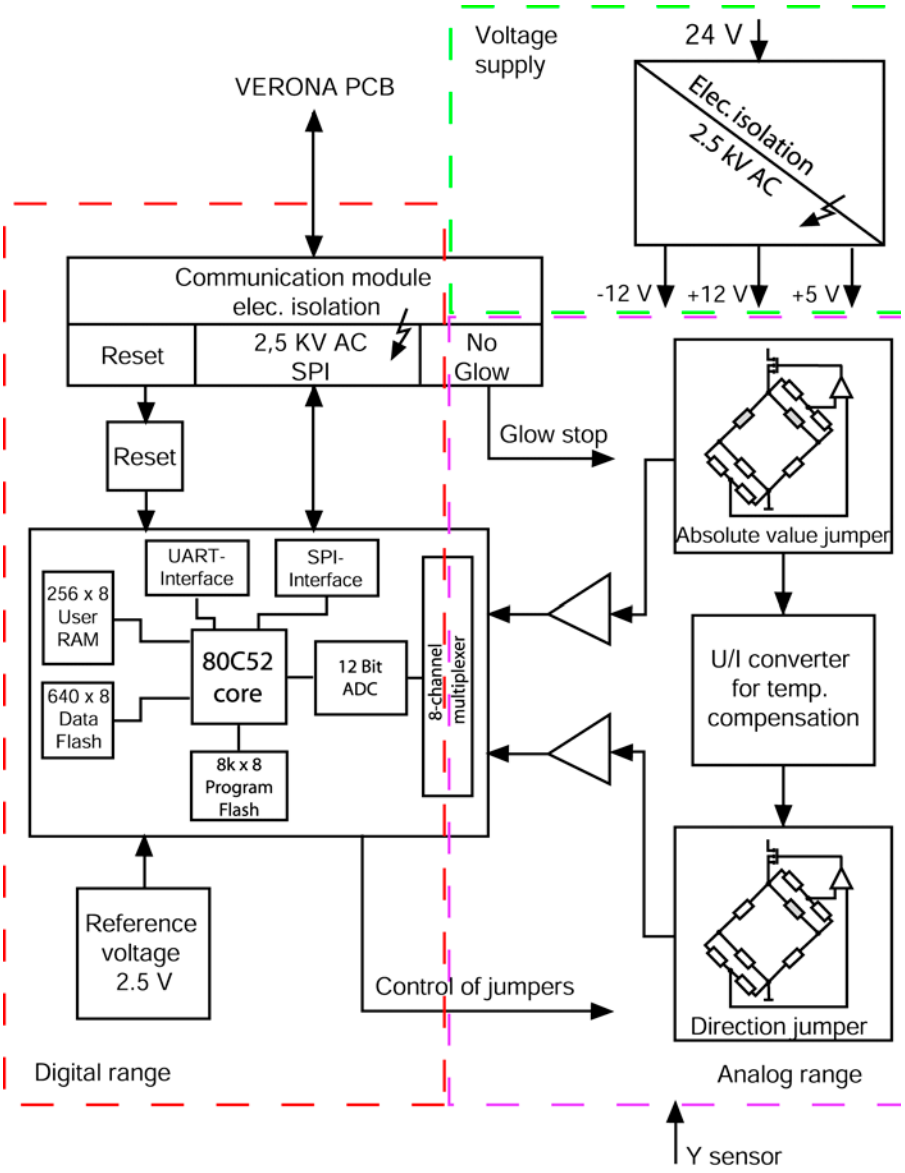

Figure 6 External Flow PCB block diagram

3.4.3 Sensor measurement principle

The “Alveon” flow sensor is based on the principle of a filament anemometer (Figure 7). In conjunction with the Zeus anaesthetic workstation, the measuring wire (2) is used for compensation of the breathing gas, the measuring wire (3) for “flow measurement” and the measuring wire (5) with the shading (4) for detecting the direction of flow.

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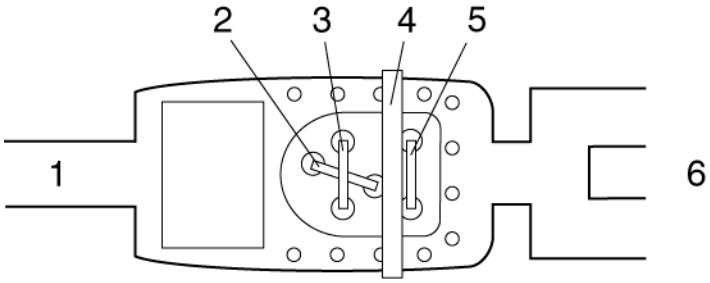

Figure 7 “Alveon” flow sensor layout

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4 CS Module

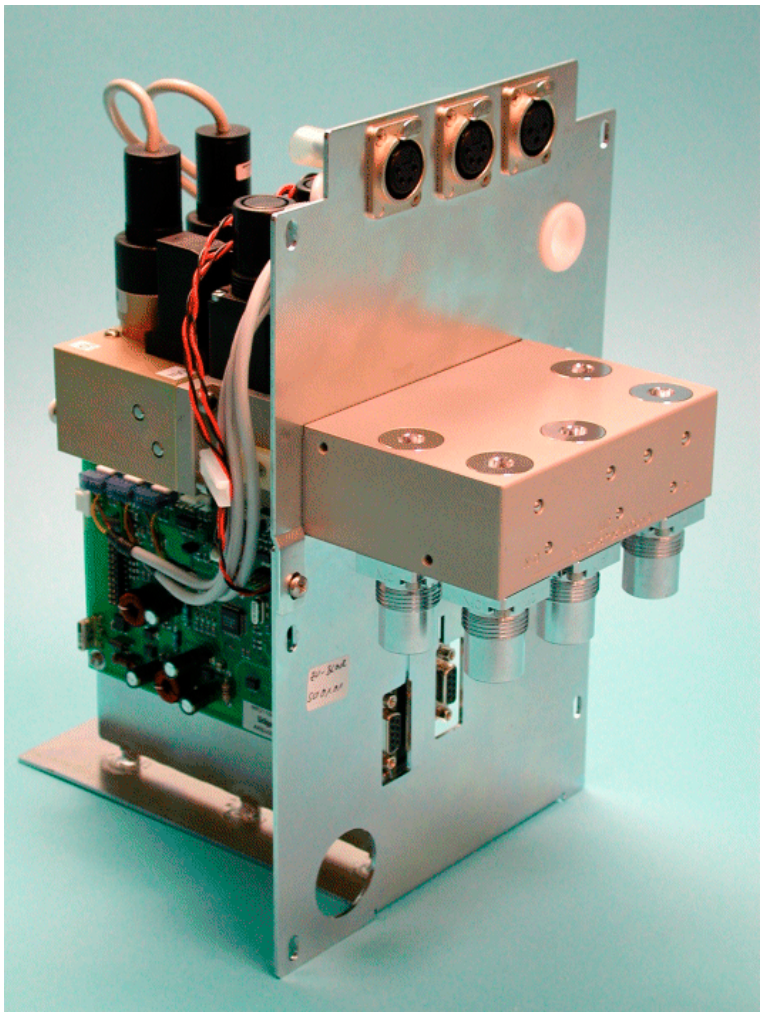

Figure 8 CS module complete

4.1 Purpose

The CS module comprises a gas carrying component, the CS Block PCB and the DAGMAR PCB.

The CS module performs the following functions:

– Feed-in of the required compressed gases by way of CS or cylinder connections
– Monitoring of the input pressures
– Reduction of the compressed gases to a level withstandable by the system

In the gas-carrying component of the CS module the compressed gases are reduced as required and fed to the relevant assemblies.

4.2 Gas supply

4.2.1 Feed-in of compressed gases with CS

The following description relates to the extract from the Zeus gas flow diagram (Figure 9).

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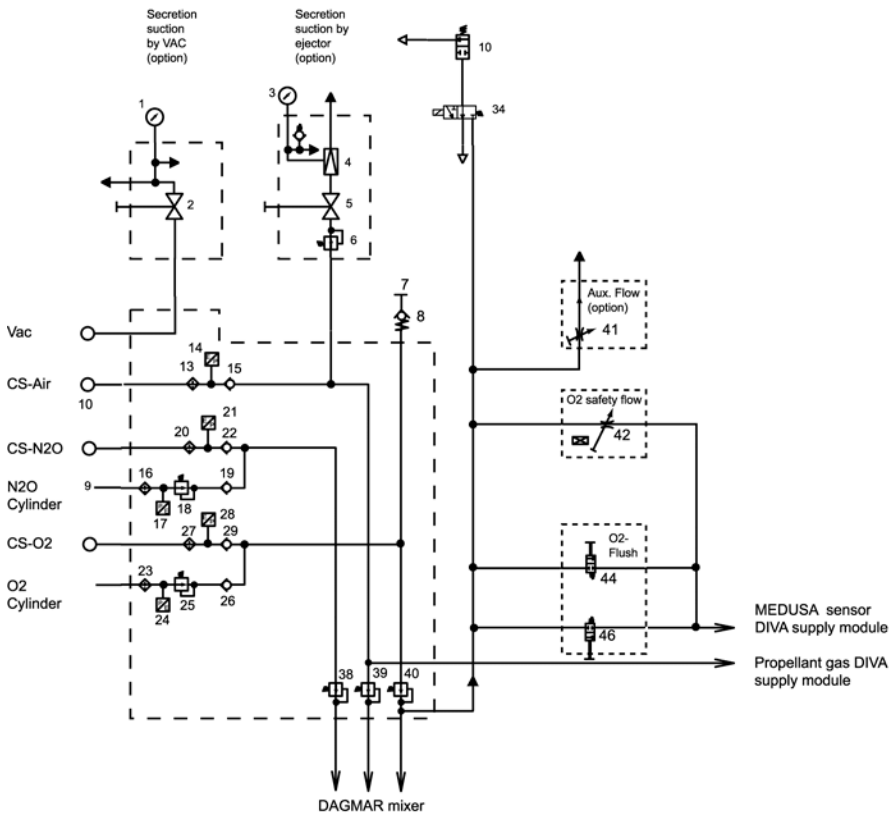

Figure 9 Extract, gas flow diagram, gas inlet block

The compressed gases O2, N2O and AIR are fed in via the CS to the gas supply block of the CS module.

The description is based on the example of O2, and is identical for N2O and AIR.
The compressed gas flows out of the CS from the CS port through the filter (27) to the pressure sensor (28). The pressure sensor signal is processed in the CS Block PCB (see also function description for CS Block PCB). The compressed gas flows on to the non-return valve (29). The non-return valve (29) prevents the gas from flowing into the open air from the connected cylinder via any CS port which may be open.

The following description applies **only to AIR**!
Downstream of the non-return valve (15) is a tap for an optional secretion suction device with ejector drive. Another tap supplies the DIVA supply module with propellant gas.

The following description applies **only to O2**!
The additional O2 outlet (7), fitted with a self-closing coupling (8), permits operation of an outpatient (Ambu) bag with oxygen metering (Oxydem) for example. In the pressure reducer (40) the compressed gas is reduced to a constant output pressure of 2.4 bar and routed to the digital gas mixer DAGMAR and to the O2 flush and the O2 emergency flow control valve. The patient system can be flushed with O2 by way of the parallel-connected O2 flush valves (44) and (46) mounted on the left and right sides of the unit. The flow is >35 L/min. By means of the “O2 safety flow” (42) flow adjuster the

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system is supplied with an O2 safety flow adjustable between 0.4 and 12 L/min. As an option, a 0 to 10L/min regulated O2 outlet for an O2 flowmeter is installed.

4.2.2 Feed-in of compressed gases with reserve gas cylinders

As an option, it is also possible to connect a maximum of 2 reserve gas cylinders.

The cylinder pressure reducer of the AIR reserve gas cylinder feeds directly into the CS AIR connection in place of the CS. The O2 and N2O reserve gas cylinders have a separate cylinder feed-in!

The following function description is based on the example of O2, and is identical for N2O.

O2 flows out of the reserve gas cylinder from the cylinder connection through the filter (23) to the pressure sensor (24). The pressure sensor signal is processed in the CS Block PCB (see also function description for CS Block PCB). The compressed gas flows on to the pressure reducer (25) and is reduced to an output pressure of 5.5 bar. The non-return valve (26) prevents compressed gas from flowing out of the connected CS line via a cylinder connection which may be open.

4.2.3 CS Block PCB

The CS Block PCB combines a processor system for pressure sensor signals and a CAN interface on a PCB (Figure 10).

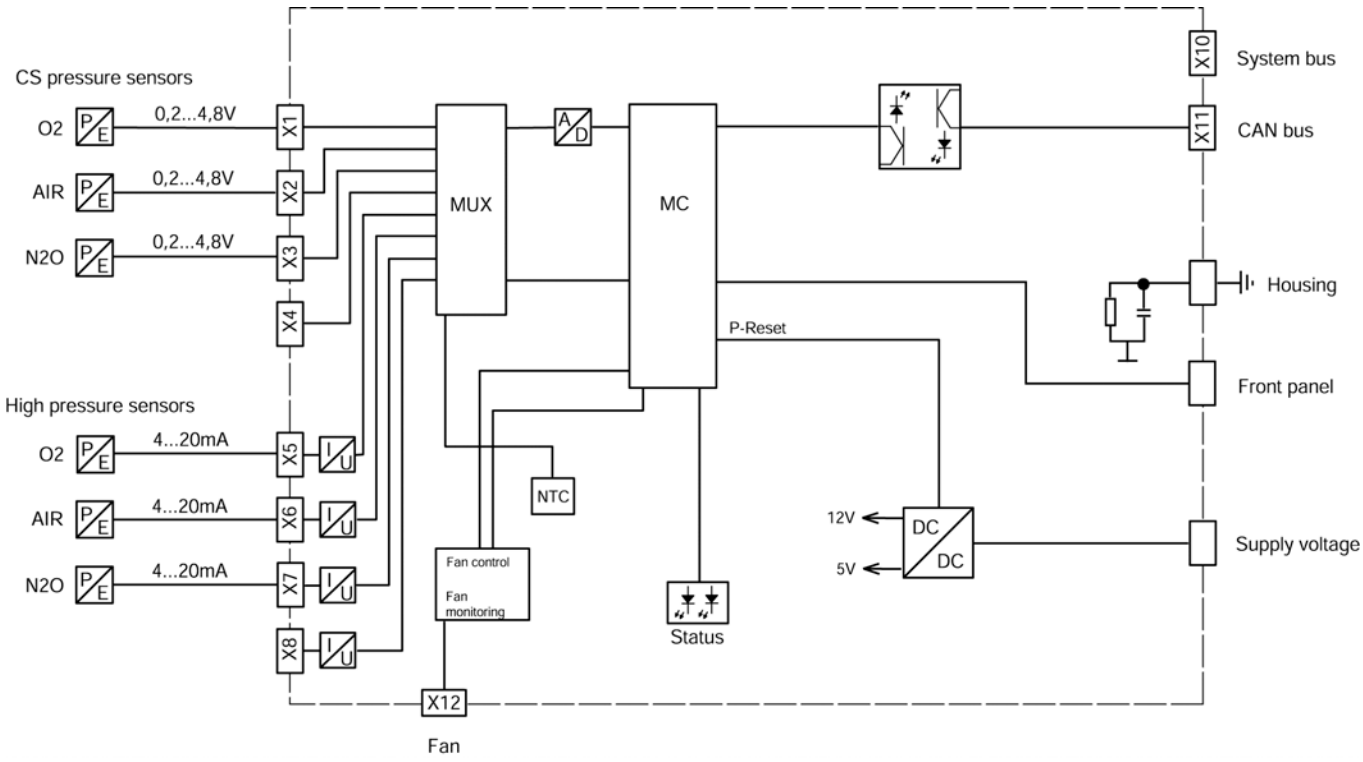

Figure 10 Block diagram of CS Pressure PCB

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The PCB the CS and reserve gas cylinder pressure sensor signals and controls the 8 indicator LEDs on the control panel of the main monitor. As long as the mains power is present, the 8 LEDs are supplied with a permanent 24 V (ULED). This means display can be maintained even when the unit is switched off.

The operating voltage for the sensors (12 V) and the processor system (5 V) is derived from the supply voltage. The input voltage is monitored by the controller.

The CS-pressure sensors operate in the range from 0 to 10 bar, delivering output voltages of 0.2 to 4.8 V which are routed by way of a multiplexer to the A/D-converter. The high pressure sensors have an additional 4 to 20 mA interface. The current signal is converted into a voltage of 0.2 to 4.8 V and likewise routed by way of a multiplexer to the A/D-converter.

The microcontroller reads in the pressure sensor signals and transfers the data as a CAN-object onto the CAN-bus. The CAN-bus is isolated by opto-coupler from the rest of the system. A green status-LED indicates the status of the data transfer to the CAN-bus. A yellow status-LED is permanently lit when the system is working properly and flashes in the event of an error. The signals to activate the 8 LEDs on the control panel of the main monitor are transmitted over the SPI bus.

AN NTC on the PCB determines the ambient temperature in the vicinity of the CS Block PCB.

4.3 DAGMAR mixed gas metering unit

4.3.1 Purpose

The DAGMAR (Digital Advanced Gas Mixer for Anaesthesia Requirements) mixed gas metering unit is a digital mixer and metering unit. The mixer and metering unit comprises the DAGMAR valve block and the DAGMAR PCB. It performs the following tasks:

– Digital mixing and metering of oxygen and either nitrous oxide or compressed air

4.3.2 DAGMAR valve block

The Dagmar valve block is divided into two separate branches (Figure 11).

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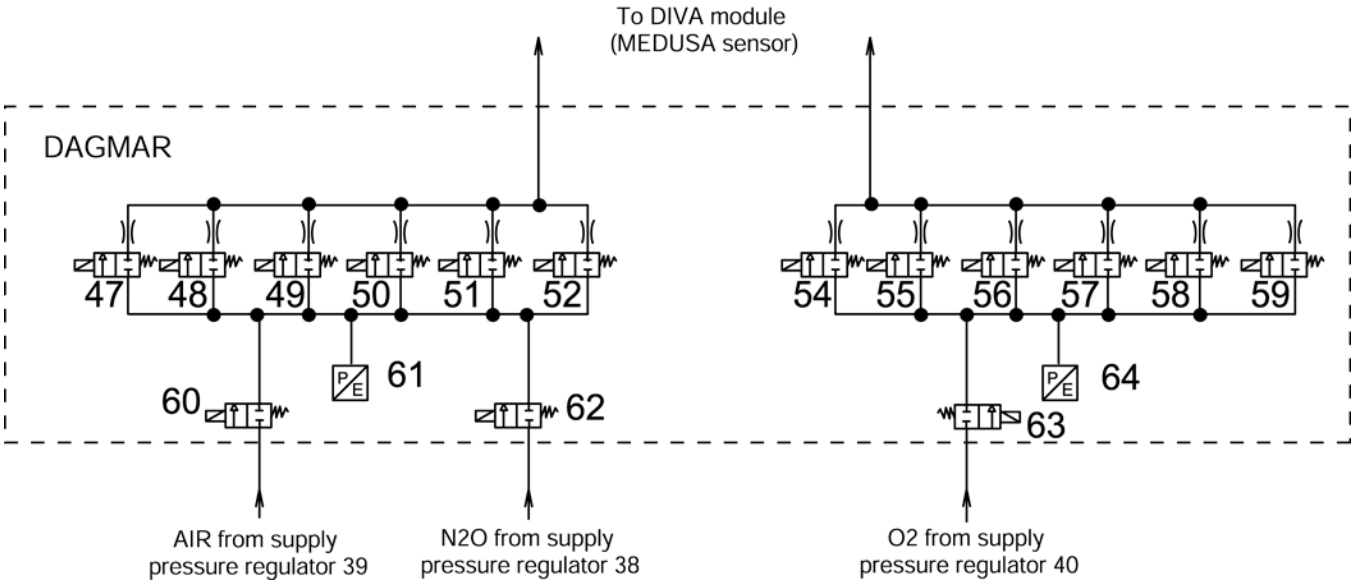

Figure 11 Extract from Zeus gas flow diagram, Dagmar valve block

One branch meters oxygen. It consists of the O2 switching valve (63), the O2 supply pressure sensor (64) and 5 digital valves (54) to (58) with downstream flow control valves for mixing. The valve (59) is clocked so the combination of valves (54) to (59) enables all possible flow values in the O2 branch to be implemented.

The second branch meters compressed air or nitrous oxide. It consists of the Air (60) and N2O (62) switching valves, the supply pressure sensor (61) and 5 digital valves (47) to (51) with downstream flow control valves for mixing. The valve (52) is clocked so the combination of valves (54) to (59) enables all possible flow values in the AIR/N2O branch to be implemented.

The outlets of both branches are routed through a flow sensor in the DIVA anaesthetic metering unit to the breathing system.

4.3.3 DAGMAR PCB

The DAGMAR PCB consists of a processor system (Figure 12) and its functions are

- to control the DAGMAR valve block
- to interface to the CAN bus
- to calculate the CS and cylinder pressures displayed on the main monitor and generate alarms from them as necessary

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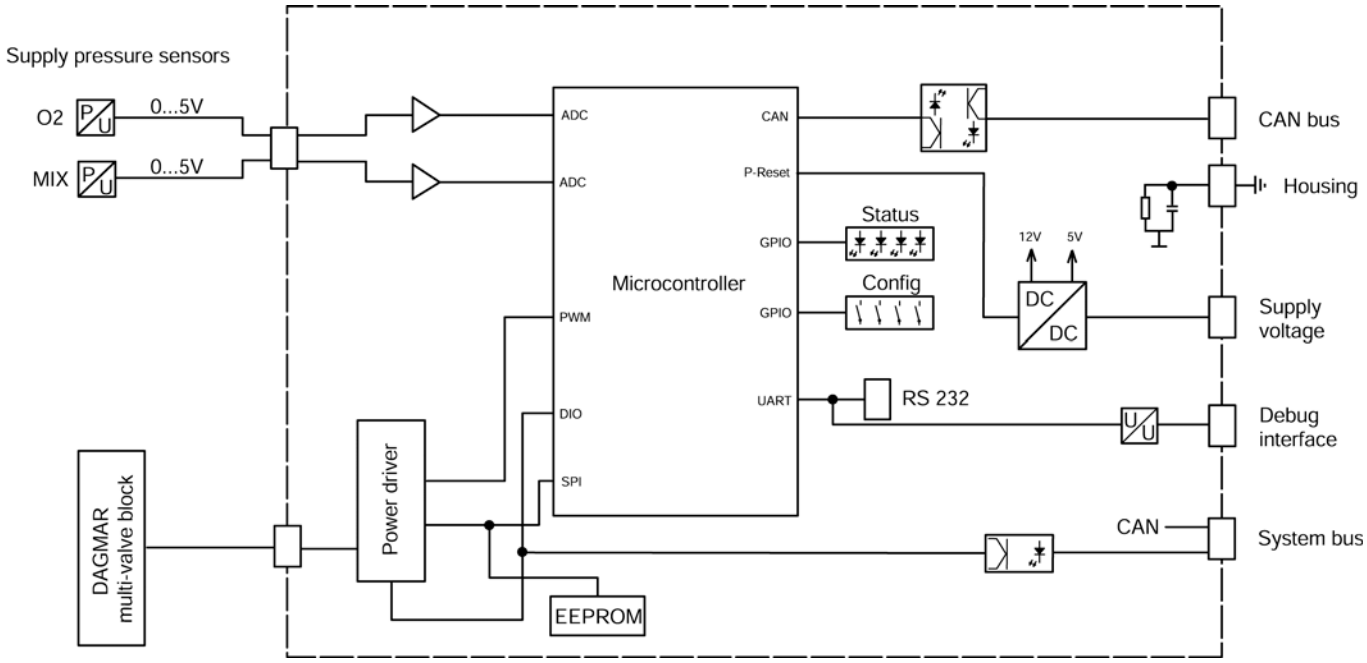

Figure 12 Block diagram of the DAGMAR PCB

The operating voltage for the sensors (12 V) and the processor system (5 V) is derived from the supply voltage. The input voltage is monitored by the processor system.

The supply pressure sensors operate in a range from 0 to 4 bar absolute, delivering an output voltage of 0 to 5 V. The processor system reads in the output voltages by way of an A/D converter and evaluates them.

The DAGMAR valve block is controlled by a power driver. In the event of an error the voltage to the power driver for the carrier gas can be cut by means of a “dead man's signal” on the system bus. For safety reasons, the signal on the system bus is electrically isolated by an optocoupler.

The processor system has a serial interface which is also configurable to TTL level.

The signals on the CAN bus, too, are electrically isolated from the rest of the system by optocoupler.

The LEDs and jumpers on the PCB are currently only used by Development, and are irrelevant to Service.

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5 DIVA Anaesthetic Metering Unit

Figure 13 Supply module with 1 connected metering module

5.1 General introduction

5.1.1 Purpose

The DIVA anaesthetic metering unit meters volatile anaesthetic. It comprises the supply module and up to 2 metering modules. The supply module is built into the anaesthetic gas-box. The metering modules are plug-in modules, and can be exchanged by the user as required. The metering modules are anaesthetic-specific. They store a quantity of anaesthetic and meter it. There are metering modules for the Desflurane, Isoflurane and Sevoflurane anaesthetics.

5.1.2 Features

The metering modules have the following properties:

– Suitable for operation in semi-open, semi-closed and closed systems.
– Anaesthetic-specific coding
– Electronic fill level indicator
– Level gauge with sight glass
– Refillable tank

The metering module feeds the metered and evaporated anaesthetic to the supply module. The supply module and the metering modules communicate via electrical and optical interfaces (Figure 14).

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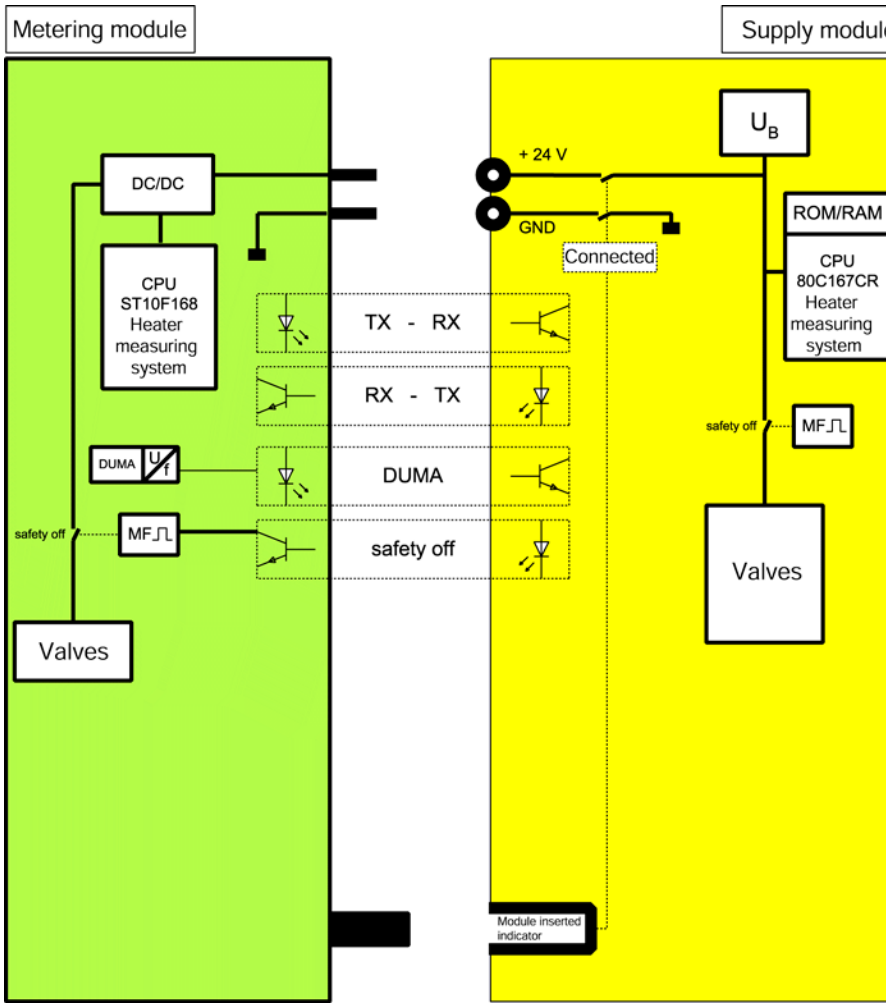

Figure 14 Optical and electrical interfaces

5.2 DIVA supply module

The supply module is not anaesthetic-specific. It holds the metering modules and provides the interface to the anaesthetic machine. The supply module principally comprises 2/2-way valves to control the propellant gas and the saturated vapour.

The supply module has two channels for left and right side mounted metering modules. The two channels are identical in design. The following function description relates to the right-hand channel of the supply module (Figure 15).

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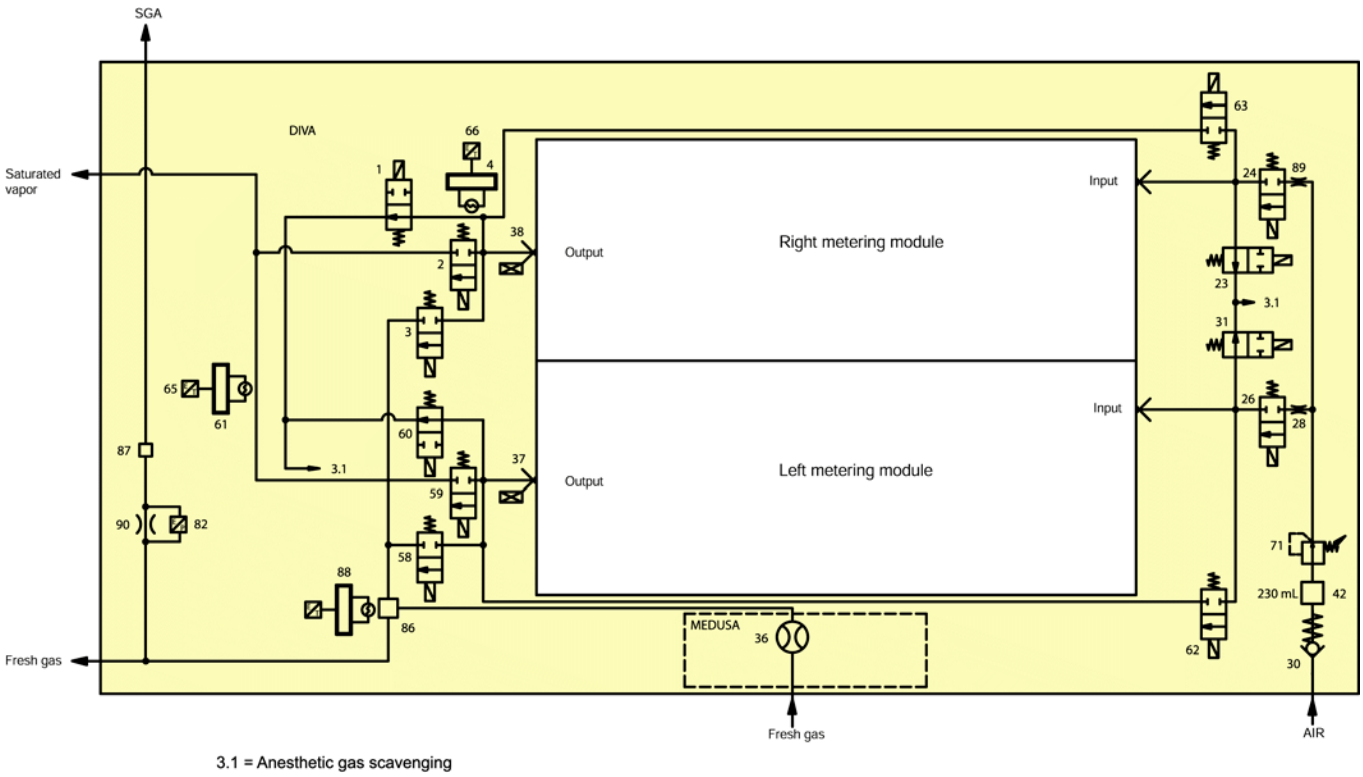

Figure 15 Supply module gas flow diagram

For safety reasons (risk of explosion), the propellant gas used is AIR. The propellant gas flows through the non-return valve (30) and the volume (170 mL) to the pressure reducer (71). There the pressure is stabilised at 2.4 bar relative. The volume acts as a pressure buffer. If the AIR fails, operation of the DIVA metering module can be maintained for a time.

In the event of an error, if the “dead man's signal” fails the supply valve (24) of the relevant channel is closed by the DIANA PCB and the pressure on the downstream line is relieved by way of the pressure relief valve (23) and the anaesthetic gas scavenging system (3.1). If there is no error, the propellant gas flows to the inlet of the metering module.

In “Auto” metering mode the anaesthetic flows from the outlet of the metering module in the form of saturated vapour (100% anaesthetic vapour) through the saturated vapour valve (2) directly into the breathing system. In “fresh gas” metering mode the saturated vapour flows through the fresh gas valve (3) into the mixing chamber (86), where it intermingles with fresh gas and passes from there into the breathing system.

In the event of an error, if the “dead man's signal” fails the saturated vapour valve (2) of the relevant channel is closed by the DIANA PCB. The outlet of the metering module is then vented by way of the relief valve (1) and the anaesthetic gas scavenging system (3.1). During the system test a check is made by way of a test valve (63) as to whether that channel is free.

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The distributor block heater (4), the mixing chamber heater (88) and the saturated vapour line heater (61) prevent anaesthetic condensing in the outlet of the supply module. The heat output is regulated with the temperature sensors (65 and 66) and the temperature sensor of the mixing chamber heater.

5.2.1 Supply Module PCB

The Supply Module PCB is located in the DIVA supply module.

The key functions of the Supply Module PCB are:

– To control the valves of the supply module
– To regulate the heaters of the supply module
– Various monitoring functions

The core of the Supply Module PCB is the microcontroller 80C167CR. The program is located in a 1 MB Flash-ROM (Figure 16).

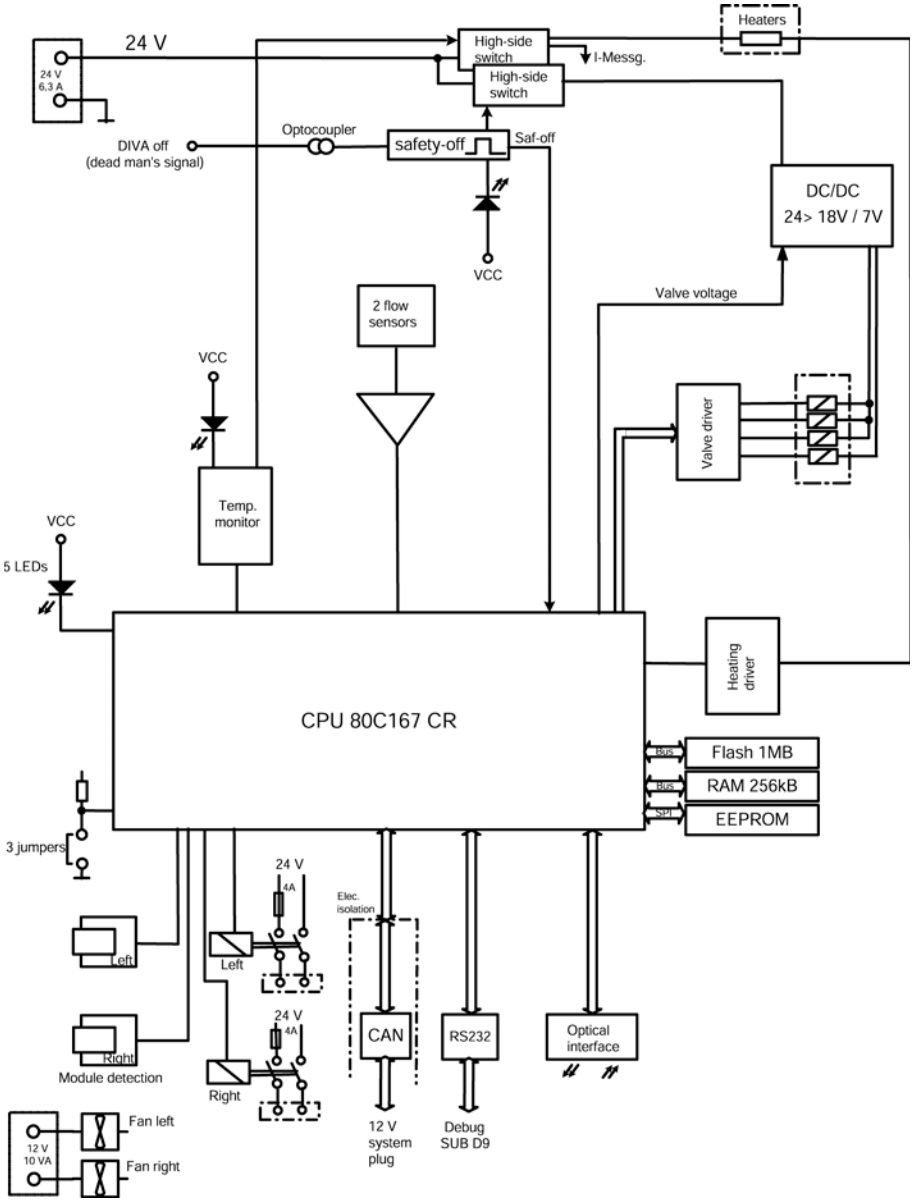

Figure 16 Block diagram of the Supply Module PCB

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The actuation valves for the left and right side metering modules are controlled by a valve driver. When the microcontroller is in Reset mode the power is cut to all valves. To minimise the power loss from the valves, the voltage is switched down from 18 V to 7 V by means of an integrated circuit (step-down regulator) once the valves have been actuated. In the event of an error, the valves are shut off in groups by way of an additional integrated circuit located in the supply voltage line (high-side switch).

The heaters in the supply module are controlled by PWM-capable switching transistors. When the microcontroller is in Reset mode the power is cut to all heaters. In the event of overheating, the heaters are shut off by the temperature monitor by way of a high-side switch.

The Supply Module PCB has 3 interfaces.

– By way of the CAN interface the PCB communicates with the other systems.
– By way of the Debug interface the software can be updated.
– By way of an optical interface the PCB communicates with the two metering modules.

When detected, each metering module is connected to the 24 V supply by way of a relay controlled by the processor. The processor also controls 2 fans by way of relay in the same way.

The Supply Module PCB also performs a number of monitoring functions. The monitoring functions include, for example, measuring the operating voltage, the heating current and the temperature, as well as monitoring the metering modules to set them to a safe state in the event of an error.

8 LEDs signal the following states:

– LED1 on = CPU reset, operation mode
– LED2 on = CPU reset, operation mode
– LED3 on = CPU reset, operation mode
– LED4 on = CPU reset, fast Task
– LED5 on = CPU reset, slow Task
– LED6 on = no overheating by heater
– LED 7 on = dead man's signal left channel on
– LED8 on = dead man's signal right channel on

5.3 DIVA metering module

The metering module is an anaesthetic-specific unit. In order to provide users with maximum possible flexibility, the metering module is of plug-in design and so can be exchanged by the user. When the metering module is not connected to the supply module the gas inlet and outlet of the metering module are closed by the spring-loaded closure valves (25) and (72) (Figure 17). All digital valves and the flow control valve are also closed.

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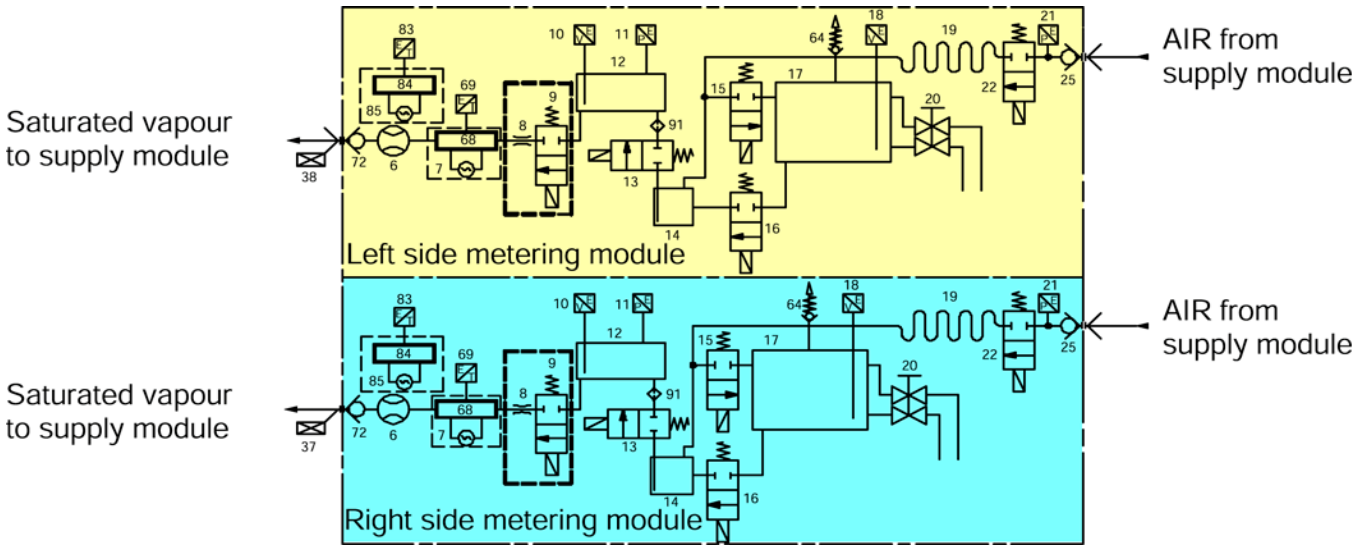

Figure 17 Metering module gas flow diagram

When the metering module is connected and locked in place, the closure valves (25) and (72) are mechanically opened. The module detector (38) detects the connected and locked metering module. The pressure sensor (21) measures the input pressure of the propellant gas.

The storage tank (17) for the anaesthetic is fitted with a capacitive level gauge (18) and a safety valve (64). The safety valve (64) opens at 1.5 bar. It activates only if the metering module is overheated, e.g. by being exposed to direct sunlight, and the vapour pressure rises. In operation, the pressure of the storage tank (17) can be relieved by solenoids (15, 22 and 23 or 15, 22 and 31) via the anesthetic gas scavenging line, so that storage tank can be safely filled at any time with no risk of anesthetic vapor escaping.

When the tank outlet valve (16) is opened, the anaesthetic in the storage tank (17) flows by gravity into the pump tank (14). At the same time, the open tank vent valve (15) vents the space above the fluid level in the pump tank into the storage tank, as otherwise the pump tank cannot be filled.

When the pump tank is full the tank outlet valve (16) and the tank vent valve (15) close. The supply pressure valve (22) opens. Propellant gas flows out of the supply module through the non-return valve (25), the supply pressure valve (22) and the buffer volume (19) to the pump tank (14) and pushes the liquid anaesthetic through the open top-up valve (13) into the metering tank.

The metering tank (12) is fitted with a capacitive level gauge (10) and a pressure sensor (11). At approx. 1.3-1.6 bar the top-up valve (13) and the supply valve (24) close. To enable the pump tank to be filled by gravity alone, the line must be vented from the pump tank through the buffer volume (19), the supply pressure valve (22) and the relief valve (23) into the anaesthetic gas scavenging system (3.1). The buffer volume (19) artificially extends the system so that no anaesthetic enters the anaesthetic gas scavenging system (3.1). This reduces anaesthetic consumption.

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The injection valve (9 and 8) injects a defined quantity of liquid anaesthetic into the evaporator chamber (7) as specified. In the evaporator chamber (7) the liquid anaesthetic is converted into saturated vapour (100% anaesthetic). The evaporator chamber heater (68) is regulated by way of the temperature sensor (69).

The DIVA embodies a sophisticated safety concept. The DUMA anaesthetic flow sensor (6) positioned upstream of the metering module outlet monitors conformance to the specified values. To prevent condensation collecting in the DUMA anaesthetic flow sensor (6), the DUMA (6) is heated by the heater (85). The heater is regulated by way of the temperature sensor (83).

If the DUMA anaesthetic flow sensor (6) measures values higher than stipulated, the supply module diverts the metered anaesthetic vapour into the anaesthetic gas scavenging system. As a result no more anaesthetic enters the ventilation circuit.

Independently of the DUMA anaesthetic flow sensor (6), the SGA also monitors conformance to the specified values, and cuts the supply of anaesthetic into the breathing system if the values are too high.

The PGA measures the actual values independently of the specified values and compares them against the pre-set alarm limits. In the event of non-conformance an alarm is generated and a user response is prompted.

5.3.1 Metering Module PCB

The Metering Module PCB is located in the DIVA metering module.

The functions of the Metering Module PCB are:

– To control the valves in the metering module
– To control the heaters in the metering module
– To measure the anaesthetic flow
– Various monitoring functions

The core of the Metering Module PCB is the microcontroller ST10F168. Only the internal RAM and ROM of the microcontroller are used (Figure 18).

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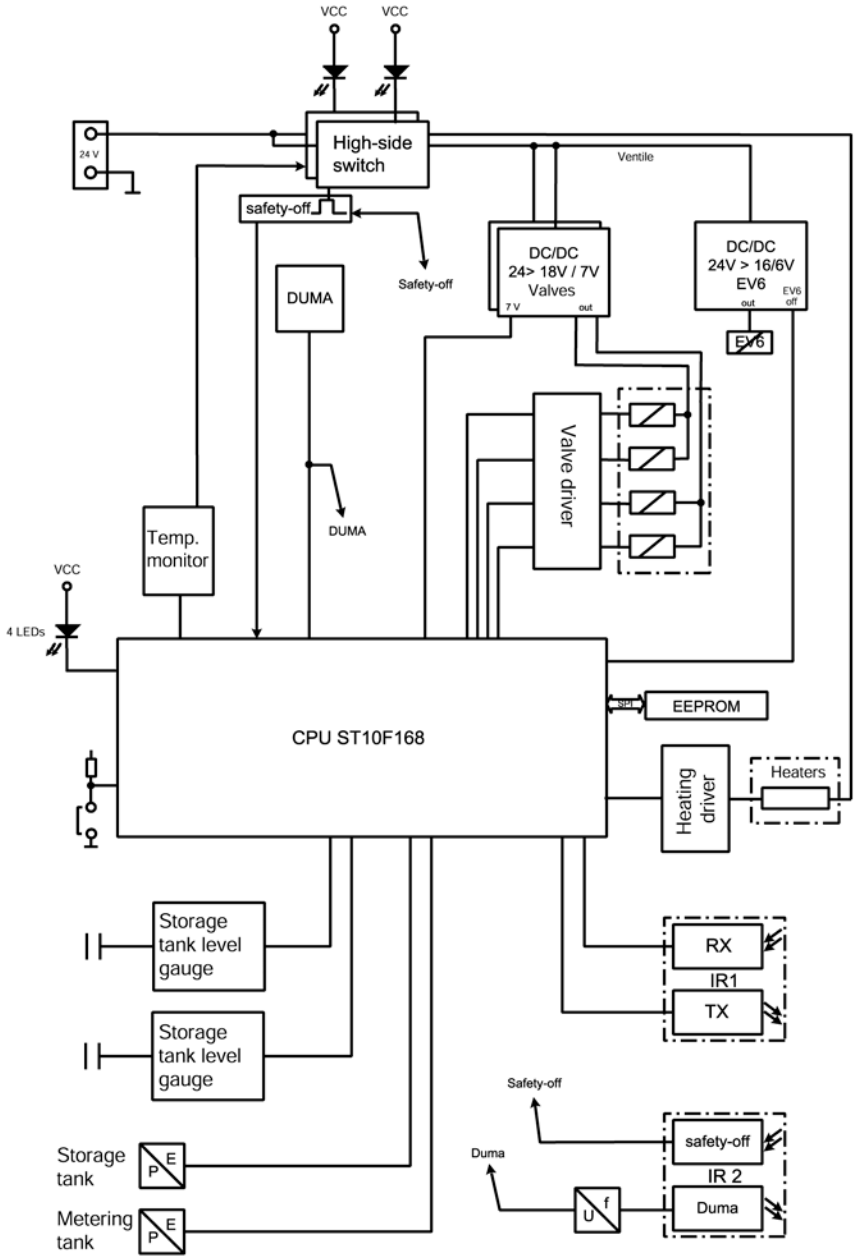

Figure 18 Block diagram of the Metering Module PCB

The valves are controlled by a valve driver. When the microcontroller is in Reset mode the power is cut to all valves. To minimise the power loss from the valves, the voltage is switched down from 18 V to 7 V by means of an integrated circuit (step-down regulator) once the valves have been actuated. In the event of an error, the valves are shut off by way of an additional integrated circuit located in the supply voltage line (high-side switch).

The heaters in the metering module are controlled by PWM-capable switching transistors. When the microcontroller is in Reset mode the power is cut to all heaters. In the event of overheating, the heaters are shut off by the temperature monitor by way of a high-side switch.

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The Metering Module PCB has a Debug interface which can be addressed optionally by way of a plug connector or via an IR transceiver. Another IR-interface (Safety) receives pulses from the supply module. If those pulses are not received, e.g. because of an error in the supply module, all the valves of the metering module are set to a safe state. The signal from the DUMA anaesthetic sensor is converted into pulses in order to safeguard independent transfer and is transferred with an IR diode.

The Metering Module PCB also performs a number of monitoring functions. Its measuring and monitoring functions include, for example, recording the pressures and fill levels in the metering module, measuring the operating voltage, the heating current and the temperature with the overheating circuit, as well as controlling the fans.

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6 Zeus Gas Measuring Module (GMZ)

Figure 19 GMZ

6.1 General introduction

6.1.1 Purpose

The function of the Zeus gas measuring module (GMZ) is to measure the gases O2, N20 and CO2 and the anaesthetics Desflurane, Enflurane, Halothane, Isoflurane and Sevoflurane for the purposes of monitoring. Two independent systems are used for this. One is a closed-loop patient-local system which taps the measured values directly at the Y-piece. The second system taps the measured values in the inspiratory branch. It monitors the loop control function and shuts down the loop in the event of an error.

6.1.2 Layout

The GMZ comprises the component assembly:

- Patient gas analyser (PGA) with
  - IRIA or ILCA 2
  - Servomex or Pato
  - Dräger water trap

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and the component assembly:

- System gas analyser (SGA) with
  - ILCA
  - OxyTrace and
  - Dräger water trap

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7 Patient Gas Analyzer (PGA)

7.1 General

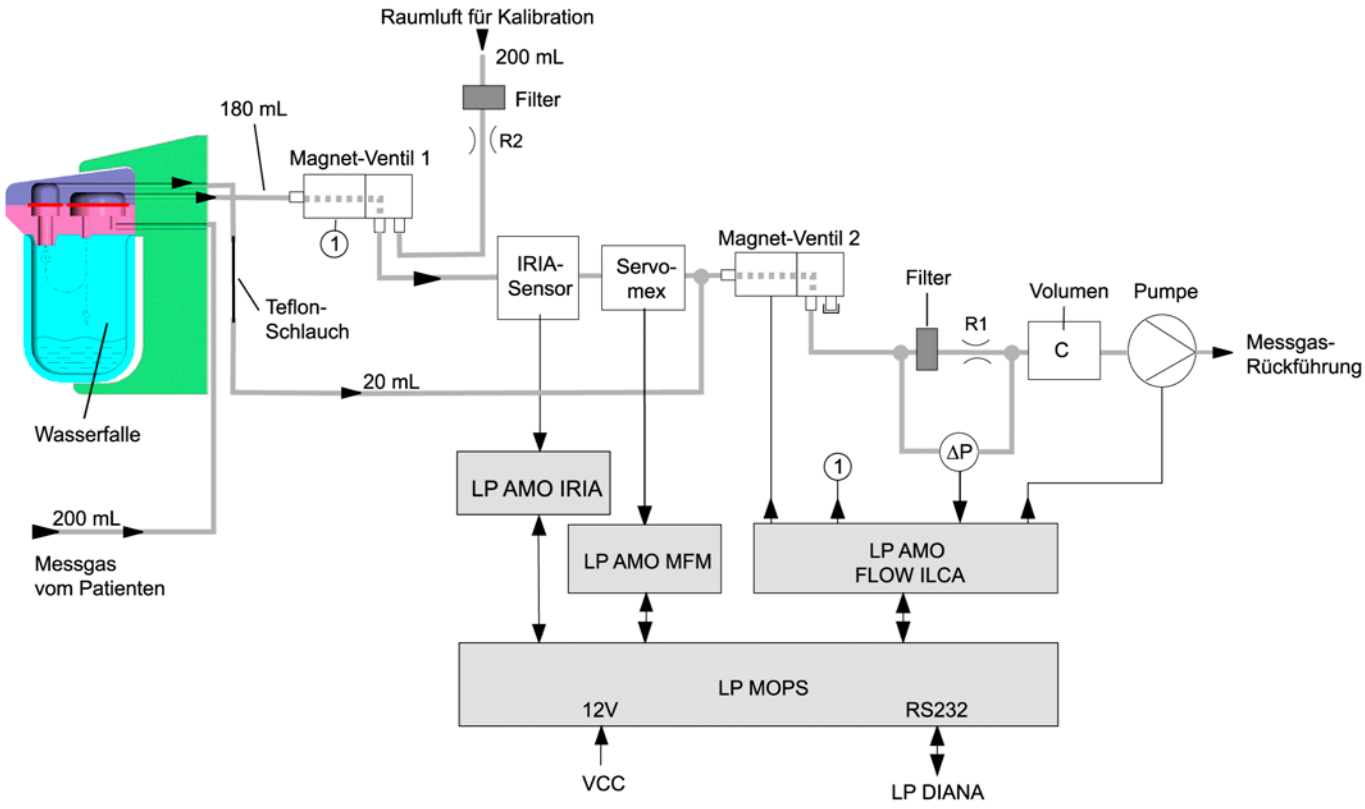

Figure 20 PGA block diagram (example GMZ)

7.1.1 Intended use

The patient gas analyzer is a complete scavenging gas analysis system for measurement of the patient gas at the Y-piece. It detects and measures the gases O2, N2O and CO2 present at the Y-piece and the anesthetics Desflurane, Enflurane, Halothane, Isoflurane and Sevoflurane. The measurement variable of the anesthetic is fed into a control loop.

7.1.2 Configuration

The PGA includes the following components:

in the **GMZ**	in the **GMZ 2**
- IRIA	- ILCA 2
- Servomex	- Pato
- Dräger water trap	- Dräger water trap

The listed components are detailed in separate function descriptions.

7.2 IRIA

The anesthetic gas measuring module detects and measures the gases CO2 and N2O as well as the anesthetic gases.

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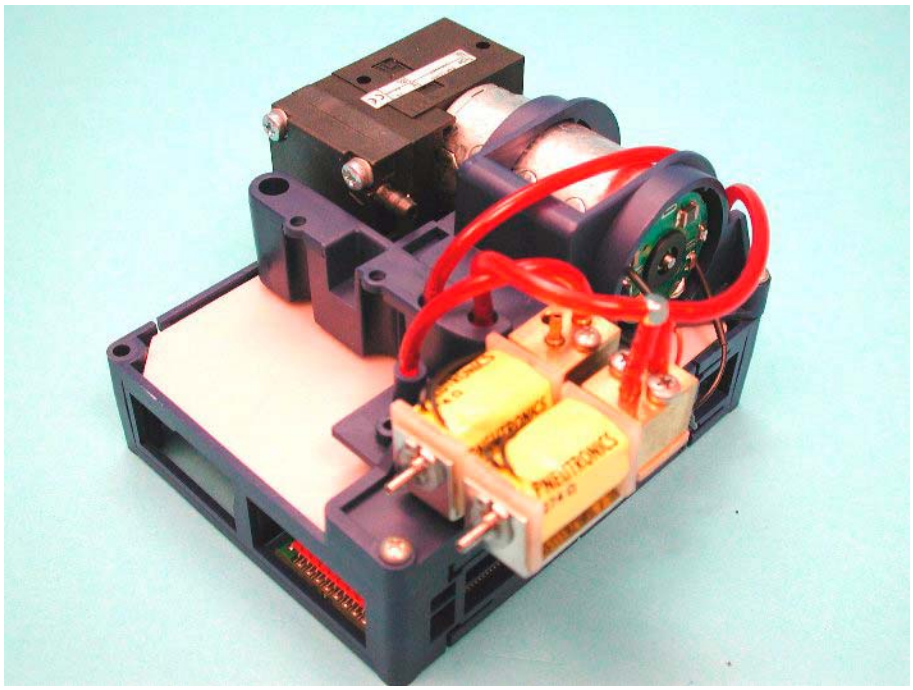

Figure 21 IRIA module without sensor

7.2.1 Intended use

IRIA is a gas measuring module for N2O, CO2 and the anesthetic gases Halothane, Enflurane, Isoflurane, Desflurane and Sevoflurane. The gas measuring module can automatically recognize the anesthetic in use.

7.2.2 Configuration

The IRIA gas measuring module principally comprises the following components:

- IRIA sensor head with Control PCB
- Pump
- Pneumatic low pass
- Solenoid valve for zero calibration
- Module rack with 4 PCBs

The module rack of the ILCA module contains 4 PCBs with the following functions:

- AMO FLOW ILCA PCB - Control of the pump and the zero calibration solenoid. A serial EEPROM stores the necessary data such as the serial number, hardware/software revision, control parameters etc.
- AMO IRIA PCB - Here the necessary supply voltages are generated and the data transfer from the IRIA sensor to the MOPS PCB is implemented.
- AMO MFM PCB - This PCB amplifies the signal coming from the Servomex.
- MOPS PCB - Primarily delivers the data for further processing via an RS 232-interface.

7.2.3 Measurement principle

The measurement principle of the IRIA (see Figure 22) is based on the infrared absorption method. A heated filament (1) is the radiation source. The infrared radiation passes through a filter wheel (2) which allows through

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wavelengths from the broadband infrared radiation in the near (NIR) and mid (MIR) ranges. Those wavelengths are use to measure CO2/N2O (NIR approx. 3 µm) and anesthetic gas (MIR approx. 9 µm).

7.2.4 Function

There are a total of 8 filters on the filter wheel:

- 3 filters for the anesthetic gases
- 2 reference filters for NIR and MIR
- 1 zeroing filter
- 1 filter each for CO2 and N2O

In the beam path downstream of the filter wheel is the cuvette (3). There the sample gas weakens the infrared radiation to a greater or lesser extent depending on its composition. These signal changes are received by the detector (4) and passed on to the evaluation electronics (5).

From those signals, the associated electronic circuit generates the values for CO2, N2O and anesthetic gases (Halothane, Isoflurane, Desflurane and Sevoflurane).

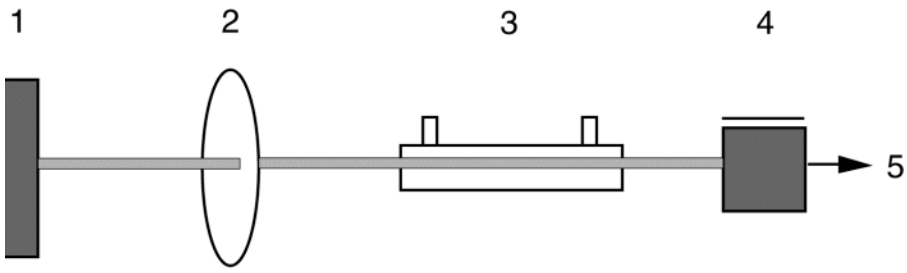

Figure 22 Schematic of the IRIA measurement principle; Legend Table 1

Table 1 Legend to Figure 22

Item	Name
1	Emitter with filament
2	Filter wheel with 8 filters
3	Cuvette
4	Detector
5	Output signal to evaluation electronics

7.3 ILCA 2

ILCA 2 is used in the GMZ 2. It is a gas measuring module for N2O, CO2 and the anesthetic gases Halothane, Enflurane, Isoflurane, Desflurane and Sevoflurane. ILCA 2 conforms to the measurement accuracy specified by ISO standard.

The gas measuring module can automatically recognize the anesthetic in use. Its function is more or less the same as that of the gas measuring module ILCA. However, an ILCA 2 sensor head is used instead of the IRIA sensor head.

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7.4 Servomex or Pato

The patient gas analyzer may be equipped with different oxygen sensors. The “Servomex” oxygen sensor is used in the GMZ. The “Pato” oxygen sensor is used in the GMZ 2.

Both oxygen sensors measure the patient's O2 concentration at the Y-piece.

7.4.1 Servomex

7.4.1.1 Measurement principle

The oxygen sensor uses the effect that oxygen molecules are attracted very much more strongly to a magnetic field (paramagnetism) than the molecules of other gases, which in some cases are repelled by the magnetic field (diamagnetism).

7.4.1.2 Function

Permanent magnets (7 and 12) in the sensor of the oxygen analyzer provide a symmetrical magnetic field (11) (Figure 23). The magnet field contains two nitrogen-filled quartz spheres (9) arranged in the form of dumbbells at the location of the highest field strength. The dumbbell is suspended rotating from a taut platinum band. A reel of platinum wire is wound around the dumbbell as a feedback coil (10).

When oxygen flows through the measuring cell (1 and 6), the magnetic field (11) changes based on the paramagnetic effect of the oxygen dependent on its concentration. This rotates the quartz spheres (9) of the dumbbells out of the magnetic field.

A mirror attached to the pivot of the dumbbell (8) reflects a light beam (5) onto a photocell pair (4). The photocells are connected to an amplifier (3) of which the output signal supplies the feedback coil (10) of the dumbbell. The dumbbell is rotated back by the current in the feedback coil (10) until the light beam (5) is illuminating both photocells (4) equally by means of the mirror (8). Then the system is at equilibrium. The current flowing through the feedback coil (10) is proportional to the partial pressure of the oxygen and thus to the oxygen concentration, which is displayed on the display instrument (2).

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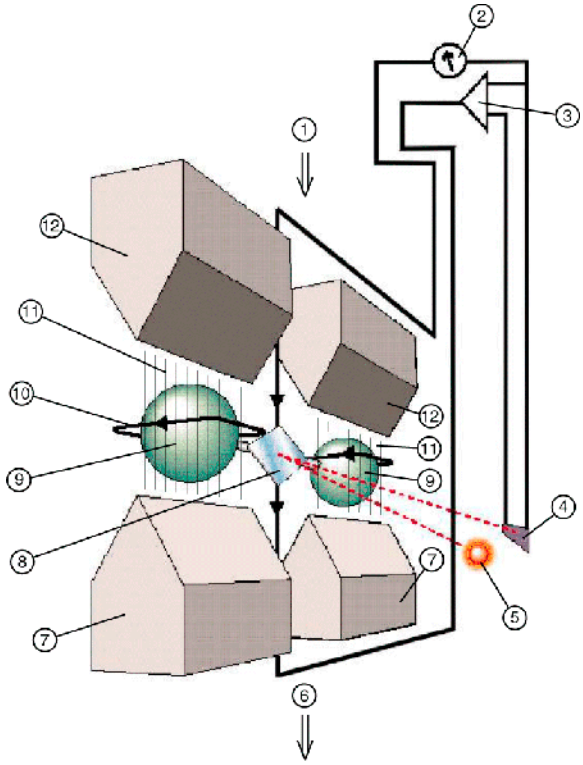

Figure 23 Schematic of Servomex

7.4.2 Pato

The oxygen sensor measures the patient's O2 concentration at the Y-piece.

7.4.2.1 Measurement principle

The PATO O2 sensor uses the fact that oxygen molecules have a stronger paramagnetic characteristic (attracted to a magnetic field) than the molecules of other gases. The oxygen molecules' orientation in a magnetic field changes the thermal conductivity of the gas mixture. The change in the thermal conductivity is used to determine the oxygen content.

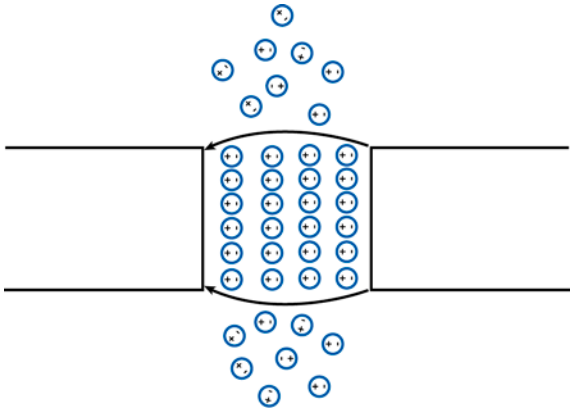

Figure 24 Oxygen molecules' orientation in a magnetic field

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7.4.2.2 Configuration

PATO O2 sensor

The PATO O2 sensor consists of the PATO SA MC PCB and PATO SA SH PCB, and the sensor head. The assemblies are contained in a housing. Communication with the medical product takes place via an RS232 interface (port). The voltage supply to the PATO O2 sensor is 10 to 36 V.

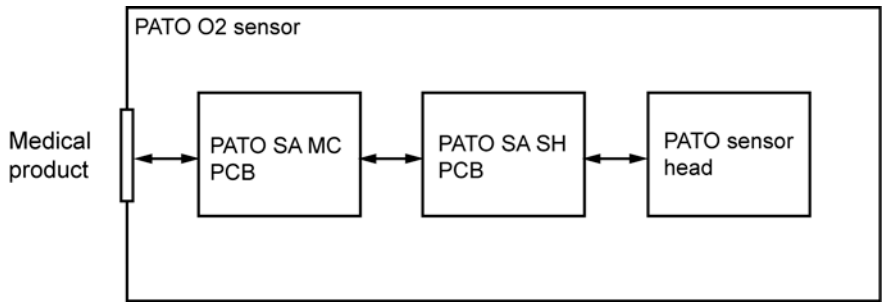

Figure 25 PATO O2 sensor configuration

PATO sensor head

The PATO sensor head contains two electromagnets, one cuvette, and one sensor element. The cuvette itself contains the gas channel and the measurement compartment.

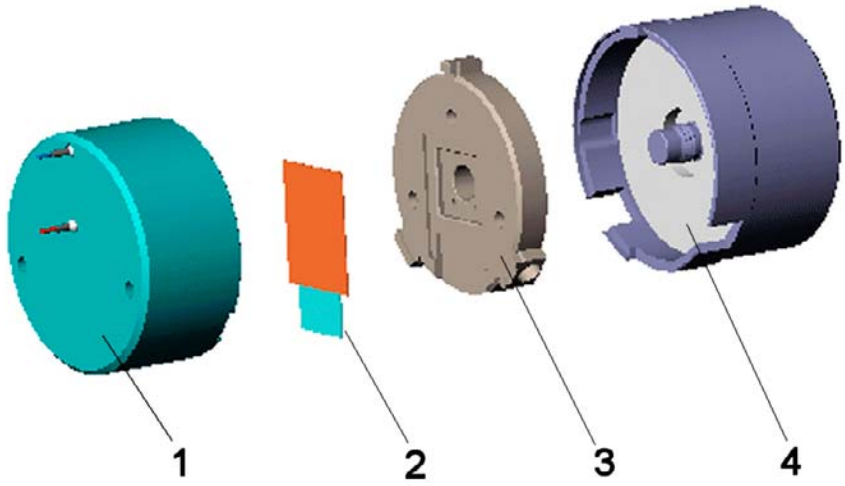

Figure 26 PATO sensor head configuration

Table 2 Legend to Figure 26

Item	Component
1	Electromagnets
2	Sensor element
3	Cuvette
4	Electromagnets

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Sensor element

The sensor element has a heating element and a thermoelement.

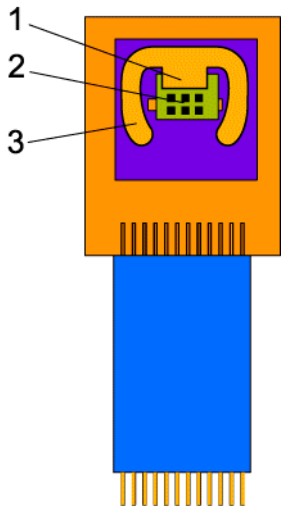

Figure 27 PATO sensor element

Table 3 Legend to Figure 27

Item	Name
1	Measurement compartment (part of the cuvette)
2	Heating element and thermoelement assembly
3	Gas channel (part of the cuvette)

7.4.2.3 Function

The gas mixture to be measured continuously flows through the gas channel. In the measurement compartment the gas mixture is only exchanged by diffusion, that is, there is no active flow.

The heating element in the PATO sensor element heats the gas mixture and the thermoelement measures the temperature.

The electromagnets generate a magnetic field which changes constantly. The oxygen molecules align with this magnetic field thus reducing the thermal conductivity of the gas mixture. This also changes the temperature at the thermoelement. The change in temperature is proportional to the oxygen content of the gas mixture.

The measuring and control signals are amplified and then converted into digital signals, or vice versa, by means of an AD/DA converter. A microcontroller system corrects these measured values and delivers them to the medical product via an RS232 interface (port).

The EEPROM on the PAT SA SH PCB contains the sensor's calibration data.

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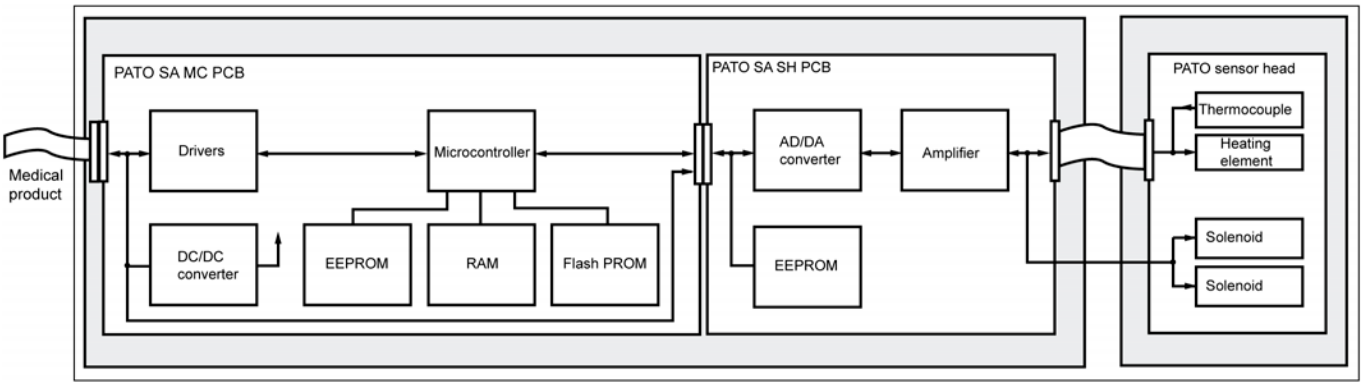

Figure 28 Block diagram

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8 System Gas Analyser (SGA)

8.1 General introduction

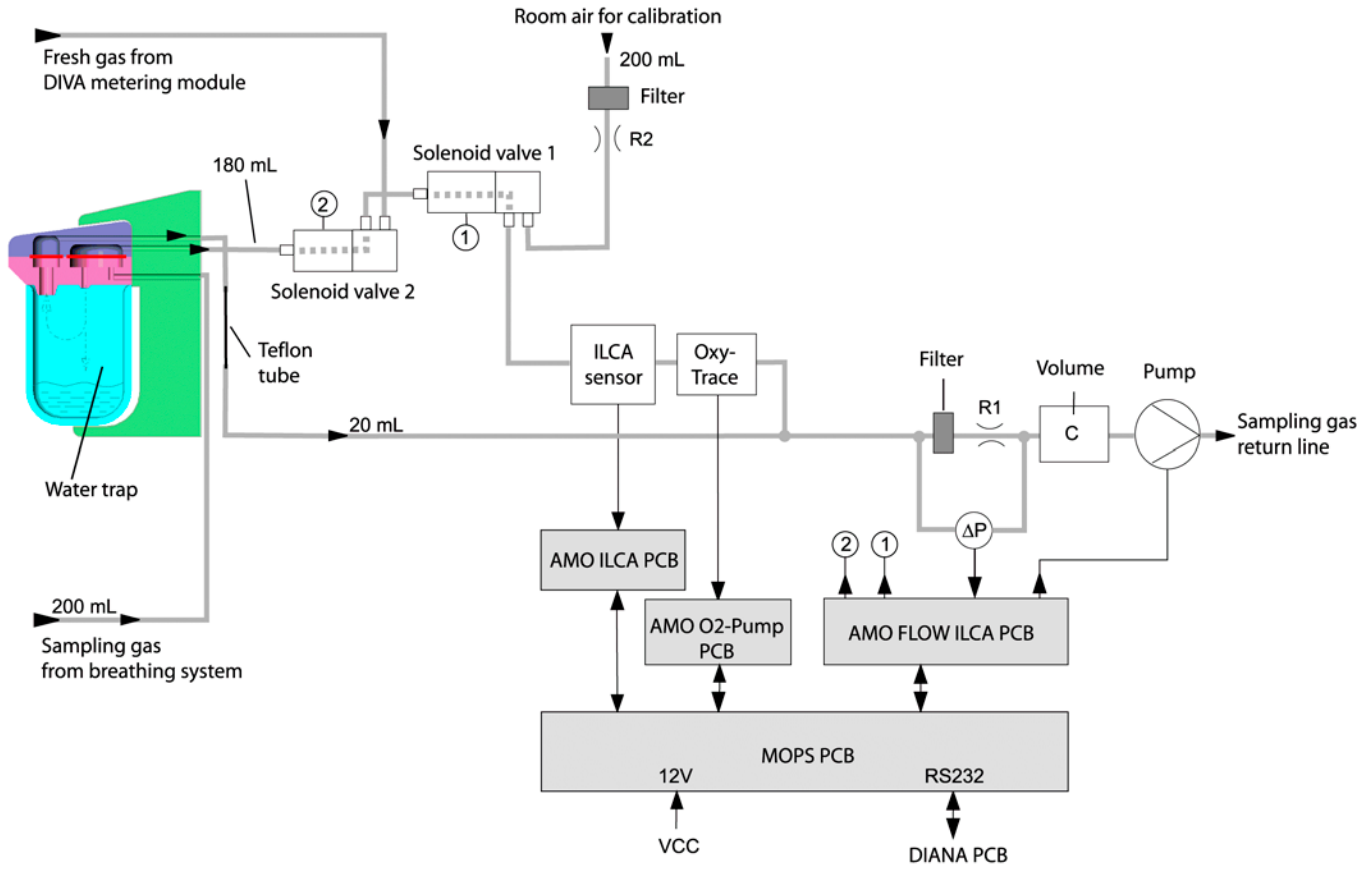

Figure 29 Connection diagram

8.1.1 Purpose

The system gas analyser is a complete scavenging gas analysis system for measurement of the gas concentration in the inspiratory branch. It measures O2, N2O and CO2 as well as the anaesthetics Desflurane, Halothane, Isoflurane and Sevoflurane. There is no automatic recognition of the anaesthetic. The system gas analyser monitors the loop control function and shuts down the loop in the event of an error.

8.1.2 Layout

The SGA includes the following components:

- ILCA
- OxyTrace
- Dräger water trap

The listed components are detailed in separate function descriptions.

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8.2 ILCA

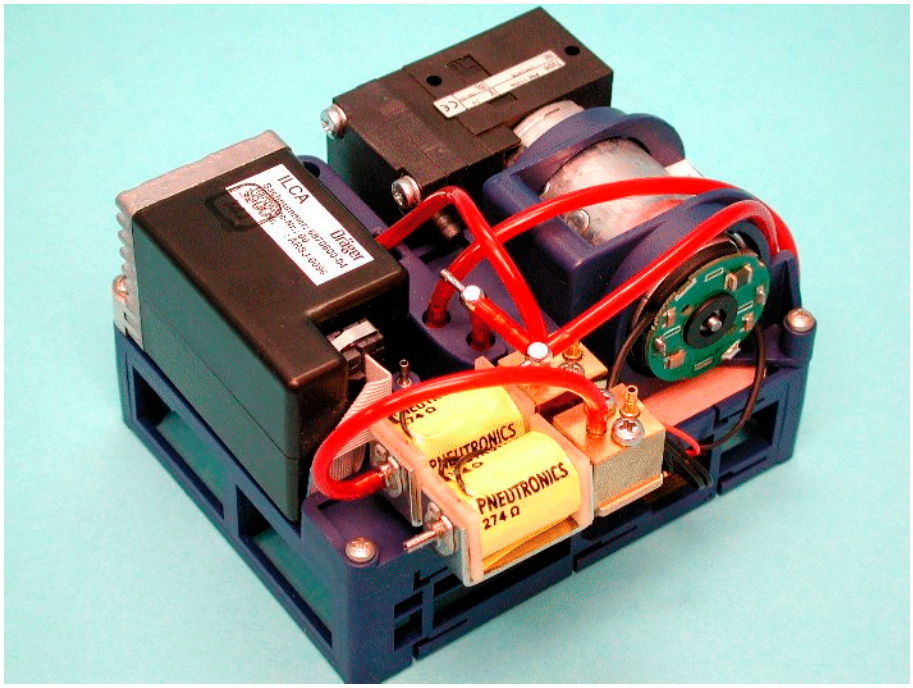

Figure 30 ILCA module complete

8.2.1 Purpose

ILCA is a gas measuring module for N2O, CO2 and the anaesthetic gases Halothane, Enflurane, Isoflurane, Desflurane and Sevoflurane. ILCA conforms to the measurement accuracy specified by ISO-standard.

The gas measuring module cannot automatically recognise the anaesthetic in use. The anaesthetic in use must be pre-selected, otherwise the gas measuring module will measure incorrectly.

8.2.2 Components

The ILCA gas measuring module principally comprises the following components:

- Sensor head with optic and electronics
- Pump
- Pneumatic low pass
- Solenoid valve for zero calibration
- Module rack with 4 PCBs
- Solenoid valve for measuring mode switch-over (fresh gas/patient gas)

The sensor head houses 2 PCBs with the following functions:

- Pre-amplifier PCB for the two multi-channel detectors
- Base PCB with emitter activation, temperature regulation, absolute pressure measurement and a serial EEPROM holding the serial number, setting and calibration data for operation of the sensor head.

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The module rack of the ILCA module contains 4 additional PCBs with the following functions:

– AMO FLOW ILCA PCB - Control of the pump and the zero calibration solenoid. A serial EEPROM stores the necessary data such as the serial number, hardware/software revision, control parameters etc.
– AMO ILCA PCB - Here the necessary supply voltages are generated and the data transfer from the ILCA sensor to the MOPS PCB is implemented.
– AMO O2 Pump PCB - This circuit board amplifies the signal from the O2 sensor.
– MOPS PCB - Primarily delivers the data for further processing via an RS 232-interface.

8.2.3 Funktion

The measurement principle of the ILCA module is based on the absorption of infrared light by the various media (Figure 31). The sensor head comprises an emitter which emits a broad spectrum of infrared light (2). The light beam passes through a cuvette (1), through which the gas being measured is also drawn by means of a pump.

8.2.4 Measurement principle

Downstream of the cuvette the light beam hits a multi-channel detector with IR filters (3 to 8). The filters are dimensioned so that only the light in the absorption wavelength of the measured gases is transmitted. If a gas is present light is absorbed. The higher the partial pressure of the gas, the greater the absorption of the light and the smaller the sensor signal.

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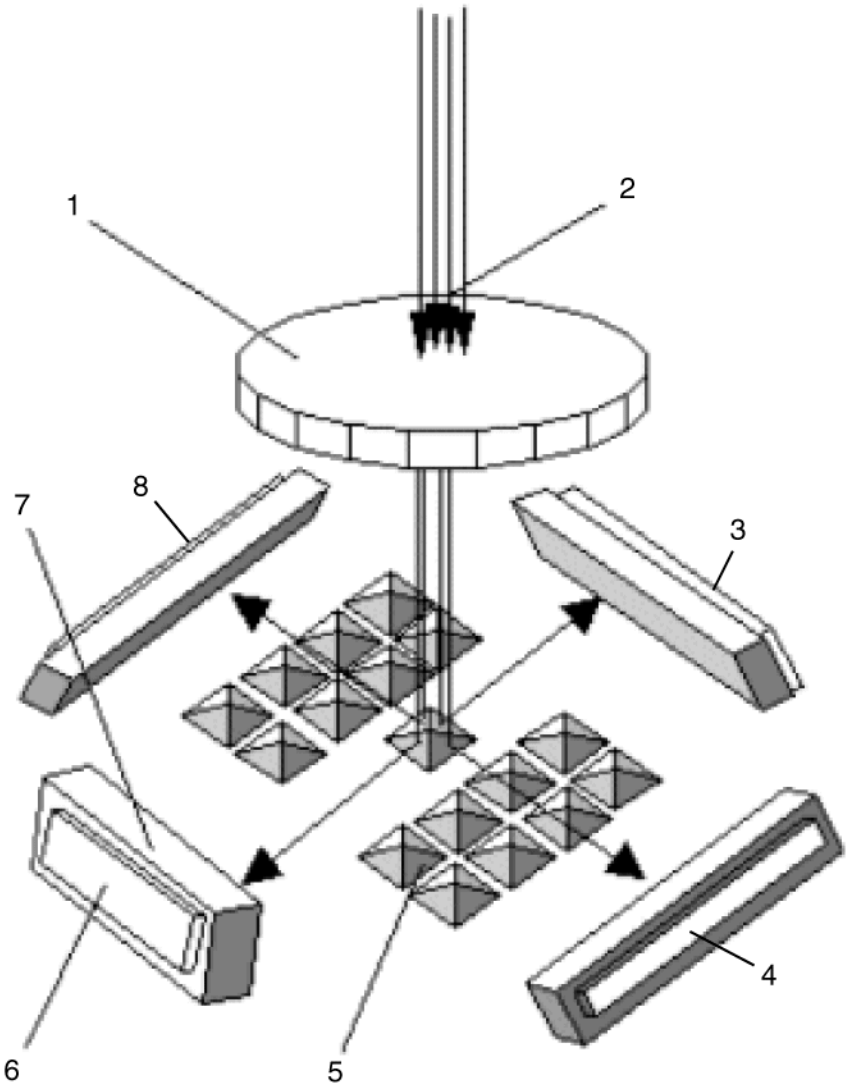

Figure 31 Principle of multi-channel detector with IR filters

Table 4 Legend to Figure 31

Item	Name
1	Sensor window
2	Infrared light
3	CO2 sensor chip with infrared filter
4	Reference sensor chip with infrared filter
5	Beam splitter (prism)
6	Anaesthetic gas sensor chip
7	Infrared filter
8	N2O sensor chip with infrared filter

The function of the pump is to draw gas out of the branch being measured through the sensor head (cuvette).

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A pneumatic low pass, comprising the volume C1 and the flow control valve R1, minimises the pressure surges generated by the pump (Figure 32).

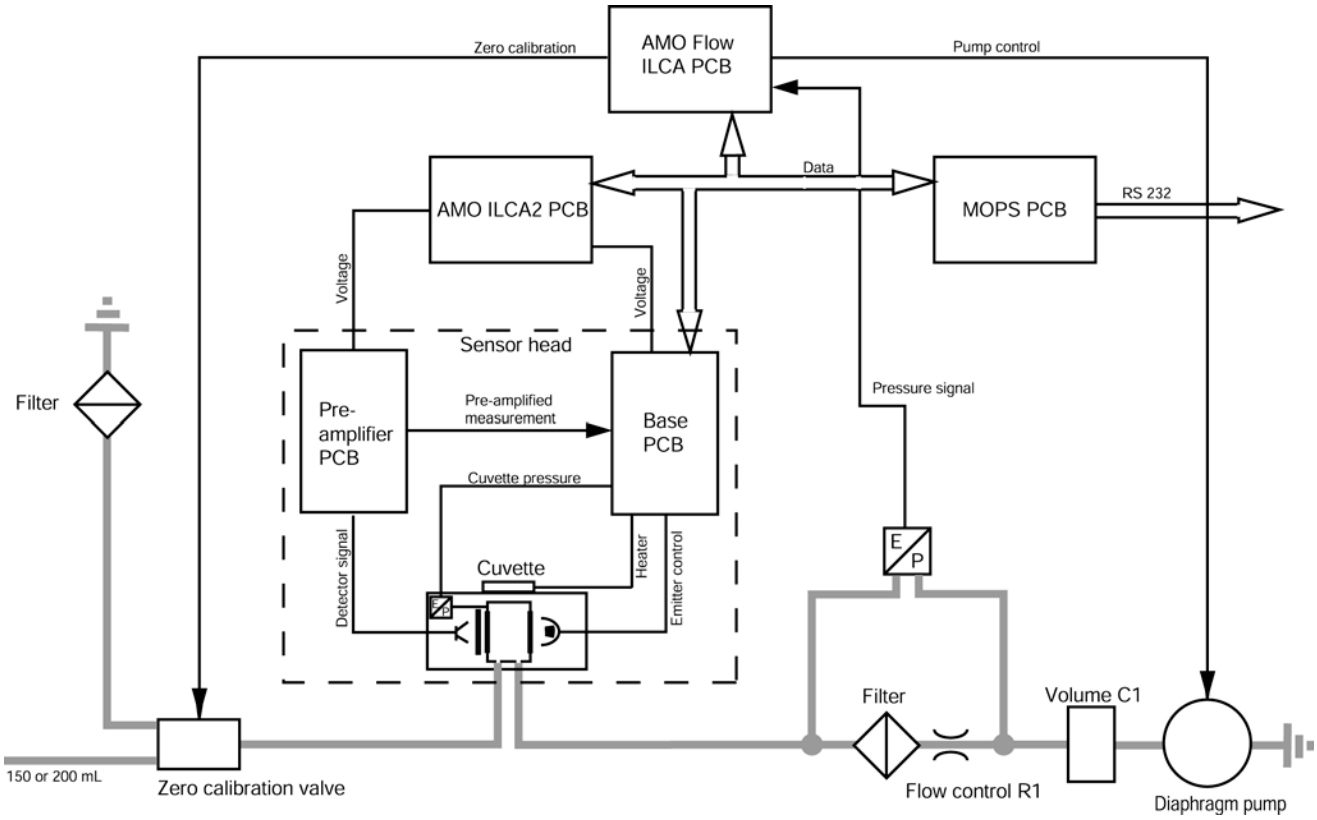

Figure 32 Block diagram of the ILCA

In substitution for a flowmeter, the pressure is measured with a differential pressure sensor upstream and downstream of the flow control valve.
The AMO FLOW ILCA PCB controls the pump with the pressure signal as the input variable.

In order to ensure an adequate measurement accuracy, an automatic zero calibration is performed periodically. For this, room air is drawn in by the pump through the zero calibration valve and passed through the sensor. The zero calibration valve is controlled by the AMO FLOW ILCA PCB, thereby calibrating the system.

Further measures to safeguard measurement accuracy:

– Heating of the cuvette so the intensity of the light beam is not affected by condensation. As the temperature also influences the measurement result, the cuvette temperature is kept constant by means of a control loop.
– The pressure in the cuvette likewise influences the result. So the pressure is measured and entered as a correction variable into the system.

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8.3 OxyTrace

8.3.1 Purpose

The OxyTrace oxygen measuring cell forms part of the system gas analyser of the Zeus gas measuring module and performs the function of recording the O2 concentration in the inspiratory branch or in the fresh gas. The measuring mode is switched by a solenoid valve.

8.3.2 Layout

OxyTrace is an oxygen measuring module with a zero-consumption electrochemical cell (Figure 33). The cell (5) is located in an aluminium housing which also contains a pre-amplifier (2). The oxygen mixture to be measured is drawn in by the ILCA pump and flows through the aluminium housing to the sensor cell. As a result of the relatively long distance through the aluminium housing the gas is brought to cell temperature. The output signal from the pre-amplifier is transmitted for further processing to the MOPS PCB of the ILCA anaesthetic gas measuring module.

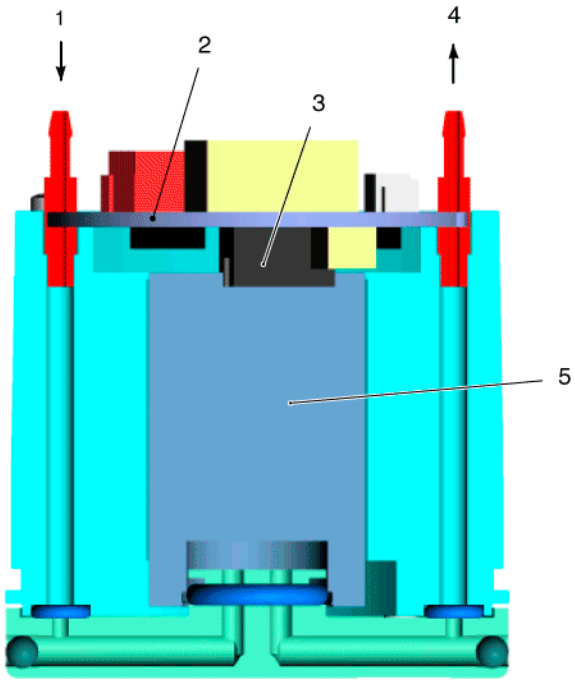

Figure 33 Layout of the OxyTrace oxygen measuring module

Table 5 Legend to Figure 33

Item	Name
1	Inlet
2	Pre-amplifier PCB
3	OxyTrace sensor connector
4	Outlet
5	OxyTrace VE sensor capsule

8.3.3 Function

The sensor is a so-called oxygen pump. This means it is an electrochemical sensor, based on the amperometry method.

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A working electrode and a counter-electrode are housed in an electrolyte-filled sensor housing. The electrolyte chamber is isolated from the gas-conducting section of the sensor by a diffusion barrier. At the working electrode, which has a potential against the counter-electrode, the oxygen diffused through the barrier is reduced. The current flow represents a measure of the oxygen partial pressure.

At the counter-electrode, oxidation of the water in the electrolyte occurs as a result of electrolysis. The oxygen formed at the counter-electrode is discharged through a pressure compensation opening to the surrounding air. This principle is termed an O2 pump.

No material transformation or decomposition occurs overall inside the sensor, resulting in longer life and improved long-term stability.

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9 Power supply unit

9.1 General

9.1.1 Purpose

The power supply unit of the Zeus supplies all the electrical components with the required voltages and currents. It has an uninterruptible power supply with rechargeable batteries.

9.1.2 Features

The power supply unit has the following features:

– All output voltages are short-circuit-proof and stable at no-load.
– Battery charging by an intelligent battery charge manager.
– In the event of power failure battery operation is possible for a minimum of 30 minutes if the batteries are fully charged.
– Temperature-controlled fan for cooling of the power supply unit.
– A CAN interface permits exchange of data and status information between the power supply unit and the anesthetic system.

The power supply unit's readiness is indicated by LEDs on the control panel of the system monitor:

Mains LED off	-	No mains power
Mains LED green	-	Mains power connected to power supply unit
Bat. LED off	-	No battery connected
Bat. LED orange	-	Charge below 50%
Bat. LED green	-	Charge above 50%
Power LED off	-	Zeus is switched off
Power LED green	-	Zeus is switched on

9.2 Mains power input

The power supply unit operates with an input voltage of 85 V to 264 V at a rated frequency of 45 Hz to 65 Hz. It is connected by way of an inlet socket for non-heating apparatus. The inlet socket for non-heating apparatus is mechanically secured against unintentional removal. The mains power cable is protected by two primary fuses in the power supply unit. A temperature-regulated fan is used to cool the power supply unit. If the temperature in the power supply unit rises due to an error, the power supply unit automatically switches to battery power.

The power supply unit has no switch. If the mains plug is pulled, the battery charge manager and the voltage supply to the indicator LEDs on the control panel of the system monitor are active.

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9.3 Output voltages

The power supply unit delivers seven no-load and short-circuit-proof output voltages (see also Figure 34):

- UBlower, 48 V/1.5 A
- UMain, 24 V/15 A
- UHERMES, 24 V/3.5 A
- ULED, 24 V/power limit 6...10 VA at 20...29 V
- UPermanent, 24 V/0.03 A
- UGA,12 V/3.5 A
- VCC-ISO, 5 V/0.1 A

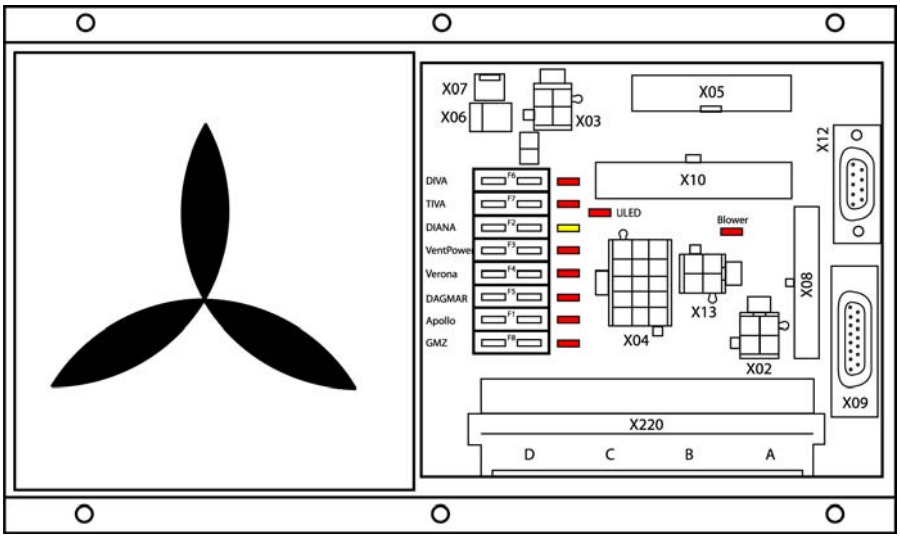

Figure 34 Power supply unit front view

Table 6 Legend to Figure 34

Item	Name
X02	Hermes computer
X03	Apollo module
X04	Transfer PCB (Power)
X05	Transfer PCB (Signals)
X06	Emergency-off button
X07	On button (Prod./Service)
X08	DAGMAR PCB
X09	Hermes monitor
X10	DIVA
X12	ZEUS motherboard
X13	Blower capacitor
F1	Apollo module (12 V/20 W), 3 A fast
F2	DIANA (24 V/12 W), 3 A fast

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Item	Name
F3	VentPower (24 V/70 W), 3 A fast
F4	VERONA PCB (24 V/70 W), 3 A fast
F5	DAGMAR (24 V/70 W), 3 A fast
F6	DIVA (24 V/300 W), 15 A fast
F7	TIVA (24 V/50 W), 3 A fast
F8	GMZ (12 V/70 W), 7.5 A fast
The following voltages are electronically protected:	
	LED voltage supply
	UGA voltage supply
	Blower voltage supply

The voltages UMain, ULED, UPermanent, UGA and VCC-ISO are connected to the same earth potential. The voltages UBlower and UHERMES are isolated.

The output voltage UMain is subdivided into separately routed and protected subsidiary voltages for different component assemblies. The states of the output voltages (ON/OFF) are indicated externally by an LED for each.

9.4 Uninterruptible power supply

NOTE
Where the term “battery” is used in the following section, it refers generally to a rechargeable battery.

The power supply unit has an uninterruptible power supply. In the event of a mains power failure the Zeus continues operating for approximately 30 minutes in normal mode under battery power. Because of their size, the batteries are fitted in the base plate. The power supply unit is equipped with an intelligent battery charge manager. Features of the uninterruptible power supply:

– The DC-input is polarised.
– Only specific batteries may be used. The battery type used can be programmed via CAN.
– The batteries are electronically protected against exhaustive discharge.
– The battery temperature and capacity are monitored during charging.
– Zeus can also be operated without batteries.

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10 Dräger Water Trap

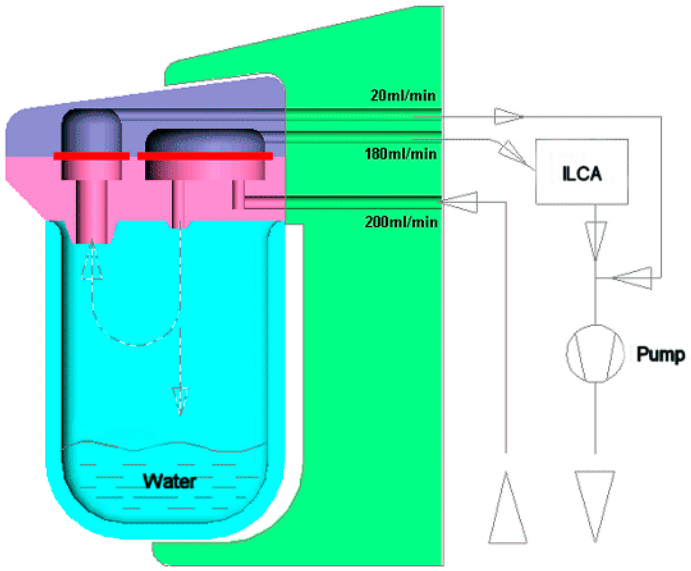

Figure 35 Principle of operation of the Dräger water trap

The Dräger water trap has two Goretex™ membranes which protect the channel to the cuvette (180 ml/min) as well as the bypass branch (20 ml/min) against incursion of damp. The water collector and the Goretex™ membranes are inseparably joined.

The water collector can be drained as often as desired using a disposable syringe. It must be replaced at regular intervals however (see relevant details in Instructions for Use).

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11 Blower

Figure 36 Blower complete

11.1 General introduction

11.1.1 Purpose

The blower is designed for use in closed systems. Its function is to generate the pressure required for ventilation. In order to improve the mix of gases in the system the blower generates a circulatory flow.

11.2 Function

The blower is based on the radial principle, and is regulated according to requirement by an electronic activation circuit. In operation the maximum ventilation pressure is 50 mbar. The control variables used are the measured values from the pressure and flow sensors contained in the breathing system.

The ventilation pressure and the circulatory flow during inhalation and exhalation are attained by means of defined activation of the blower (21) and the flow valve (6) in the breathing system (Figure 37). Fresh gas is drawn out of the manual breathing bag (27).

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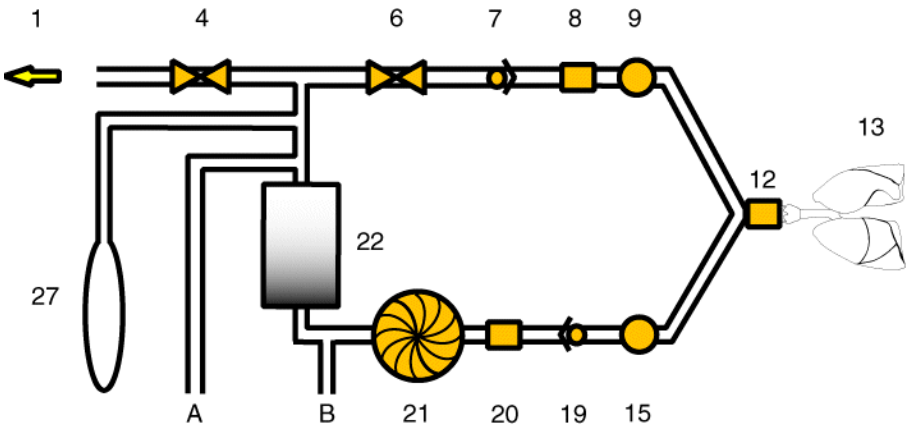

Figure 37 Breathing system, simplified view

The blower has the following properties:

– The patient gas carrying components can be sterilised at 134 degrees C in hot steam. An exception to this is the blower spindle. It is protected by the filter and is replaced every 2 years.
– The blower is suitable for supporting spontaneous breathing.
– The blower can be "breathed through" at standstill.

The blower comprises a brushless electric motor (Figure 38). Three Hall sensors are fitted in the motor. They signal the rotor position to the activation circuit. From this information the position and direction of the driving magnetic field is then determined.

An NTC (4) monitors the motor temperature. A fan (5) installed underneath the motor prevents heat build-up at the motor during operation.

The radial blower (2) is located above the motor in a separate housing. The spindle of the blower wheel is sealed by a magnetic fluid. The magnetic fluid is a viscous polymer into which iron particles have been mixed. The iron particles keep the fluid at the intended sealing point, based on a ring magnet. As a result the spindle is leak-tight to 140 mbar.

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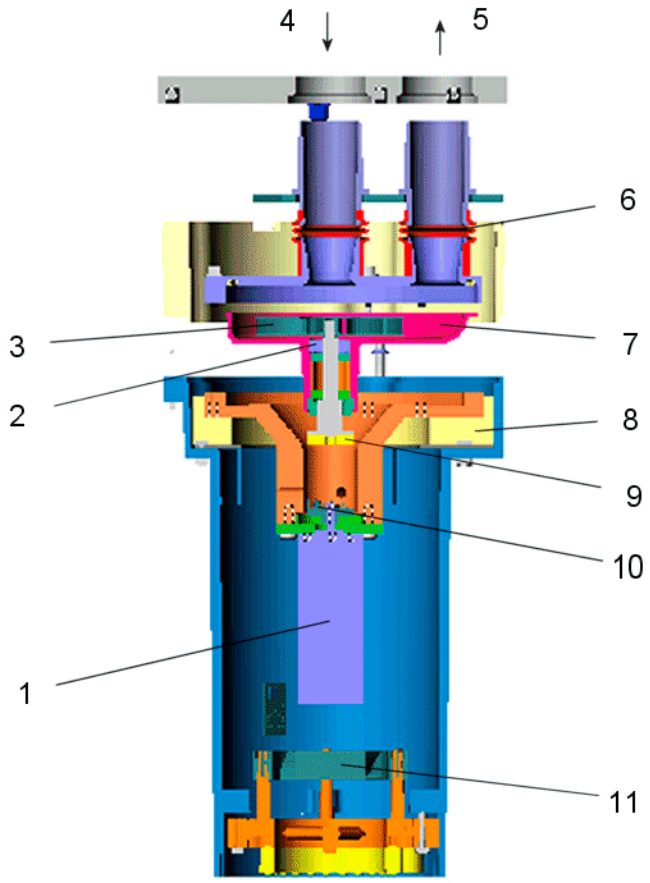

Figure 38 Blower sectional diagram

Table 7 Legend to Figure 38

Item	Designation
1	Electric motor
2	Magnetic fluid seal
3	Blower wheel
4	Blower inlet
5	Blower outlet
6	Bellows
7	Blower spindle
8	Foam
9	Felt disc (coupling)
10	Needle coupling
11	Fan

Low noise based on absorption of vibration by magnetic fluid seal (2), silicone (6) and foam (8).

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12 Breathing System

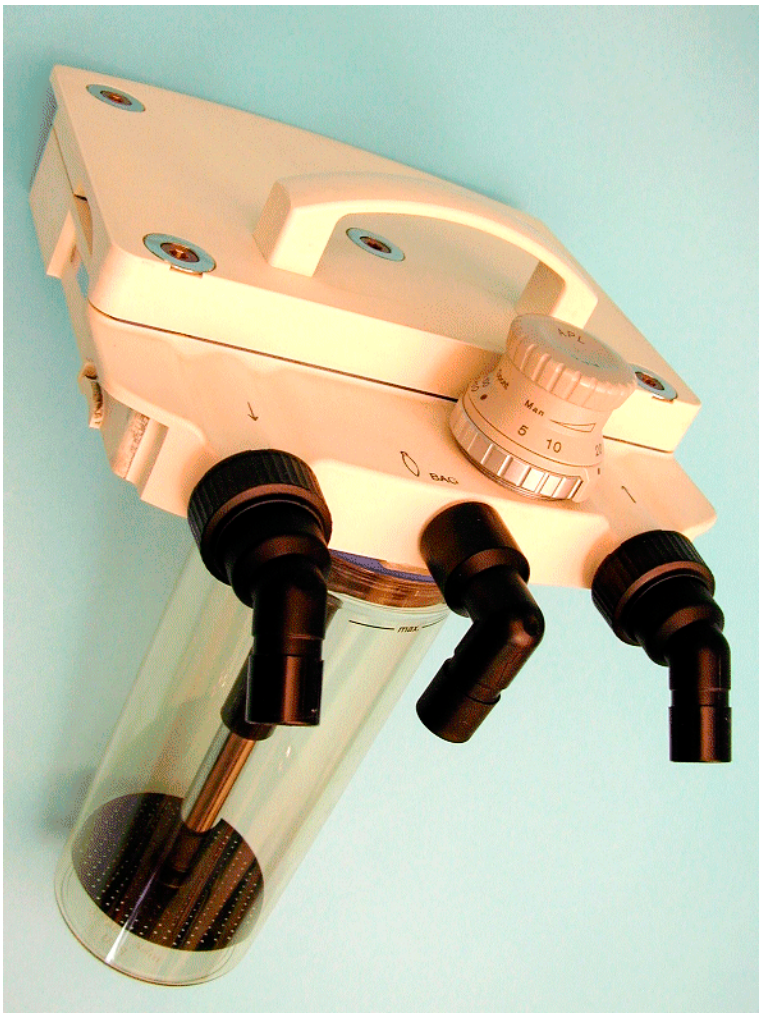

Figure 39 Breathing System

12.1 General introduction

12.1.1 Purpose

The function of the breathing system is to control the gas flow and the pressure in the breathing system as specified. Gas breathed back into the breathing system has CO2 removed from it by means of a soda lime absorber and is re-used. In the closed system the consumption of gas and volatile anaesthetic is thereby reduced to a minimum.

12.1.2 Features

The breathing system is a compact breathing system with the following properties:

– Suitable for operation in closed and semi-closed systems.
– Removable from the base unit as a complete unit.
– Automatic connection of all interfaces/sensors.
– Contaminated surfaces can be disinfected or sterilised.

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The breathing system is adapted onto the side of the Zeus housing at the pneumatic interface. The interface provides the mechanical, pneumatic and electrical connections to the anaesthetic gas box. It also accommodates the Valve Control PCB and the Pressure/Flow PCB. Two inductive senders at the connection point signal inadequate locking of the breathing system.

12.2 Components in the breathing system and their functions

To implement the ventilation modes a certain amount of hardware is required (Figure 40).

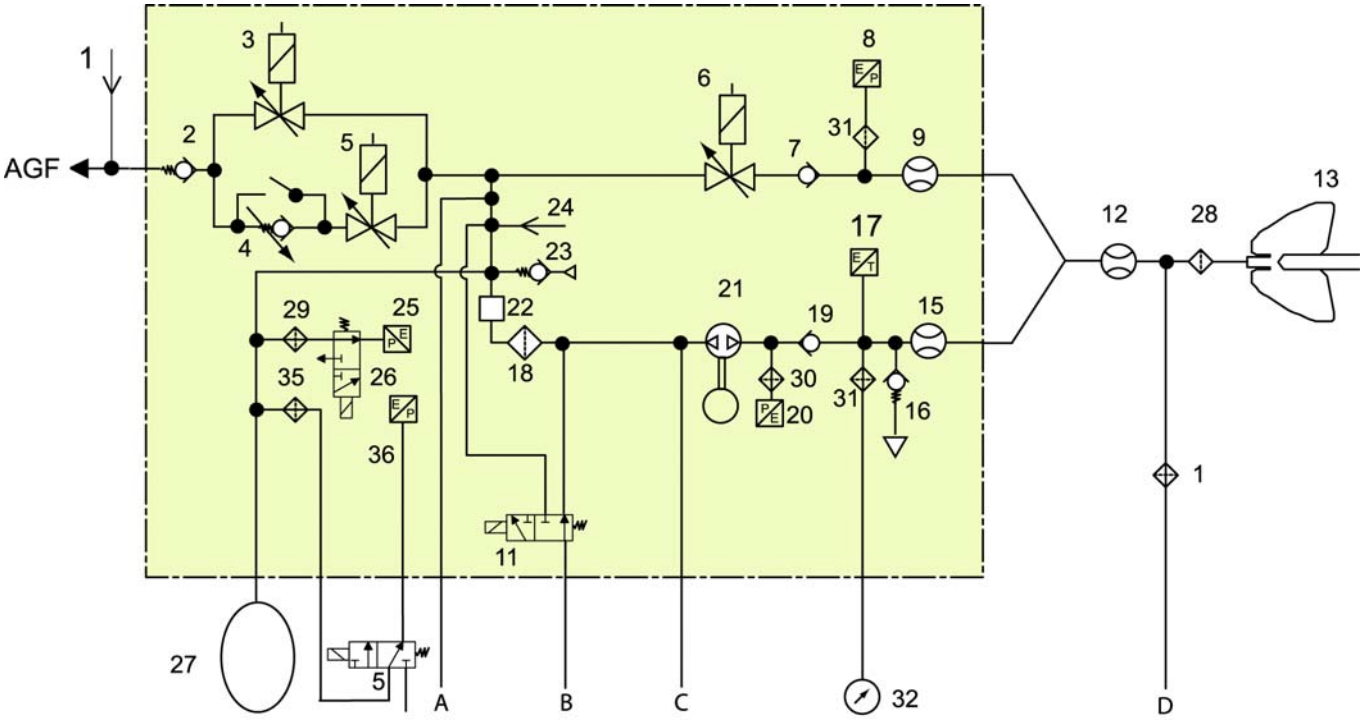

Figure 40 Function diagram of breathing system with blower

The functions of the various components are explained in the following irrespective of any specific ventilation mode.

Table 8 Components and their functions

Item	Name	Function
A	Saturated vapour inlet	Introduction of saturated vapour into the breathing system
B	Fresh gas inlet	Introduction of fresh gas into the breathing system
C	Sampling gas aspirator SGA	Suction of sampling gas, when working in loop control mode.
D	Sampling gas aspirator PGA	Suction of sampling gas

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Item	Name	Function
1	Feed into anaesthetic gas scavenging system	Scavenging of surplus gas
2	Non-return valve of anaesthetic gas scavenging system	Inflates manual breathing bag by means of spring force. Prevents breathing-back from anaesthetic gas scavenging system
3	Closed valve	Works as an On/Off valve. Defined venting possible independently of APL valve.
4	APL valve	Adjustable pressure-limiting valve. At “SPONT” setting zero-resistance continuity.
5	Spont valve	Works as an On/Off valve. Defined closure of the APL valve.
6	Flow valve	Works as a proportional valve. Provides the circulatory flow and the PEEP.
7	Expiration-side non-return valve	Prevents breathing-back of exhaled gas.
8	Expiration-side pressure sensor	Monitors the inspiratory pressure sensor. Controls the blower regulation during inspiration. Measures the airway pressure.
9	Expiration-side flow sensor	Regulates the circulatory flow in the inspiratory phase under pressure-controlled ventilation. Compensates for the expiratory breathing resistance in the expiratory phase.
11	Fresh gas switch-over valve	Standard: Fresh gas is fed in from the absorber. In the event of failure of the blower the fresh gas is fed in downstream of the absorber.
12	Y-piece with flow sensor	Records the measurements for VT, MV and flow for real-time curve and loop. Controls the ventilation (flow trigger, flow criterion for ending a breathing stroke).
13	Patient's lung	-

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Item	Name	Function
15	Inspiration-side flow sensor	Regulation of the inspiratory flow under constant-flow ventilation. Measurement of the tidal volume under constant-volume ventilation. Regulation of the circulatory flow in expiration.
16	Breathing system safety valve	Limits the max. pressure in the system and thus at the patient.
17	Respiratory gas temperature sensor	Measures the respiratory gas temperature.
18	Microbial filter in absorber	Holds back soda lime residues and prevents contamination of the blower spindle.
19	Inspiration-side non-return valve	Prevents breathing-back of expiratory gas into the inspiratory branch.
20	Inspiration-side pressure sensor	Monitors the expiratory pressure sensor. Monitors the airway pressure. Regulates the blower during expiration.
21	Blower	Generates the circulatory flow and the ventilation pressure.
22	Absorber	Absorbs CO2.
23	Auxiliary air valve	Opens at a negative pressure of approx. -20 mbar.
24	Feed-in point of measurement gas return	Return flow of gas drawn from SGA and PGA.
25	Breathing bag pressure sensor	Measures the pressure in the manual breathing bag.
26	Calibration valve	Sets the pressure sensor (25) to ambient pressure.
27	Breathing bag	Serves as a reservoir. Receives the expiratory volume.

12.3 Function

The following function description relates to Figure 41 Breathing system, simplified view.

Inlet “A” receives fresh gas in Fresh Gas mode or fresh gas and saturated vapour in Auto mode. Inlet “B” receives fresh gas if there is no circulatory flow (e.g. if the blower fails).

Inspiration:

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The blower (21) is pressure-regulated and speed-limited. It conveys gas from the breathing bag (27) through the absorber (22) and the non-return valve (19) into the patient's lung (13). The inspiratory pressure is regulated with the blower and the proportional valve (6).

Expiration:
When expiration begins the proportional valve (6) opens. The gas flows out of the lung (13) through the expiratory non-return valve (7) and the proportional valve (6) back into the breathing bag (27).

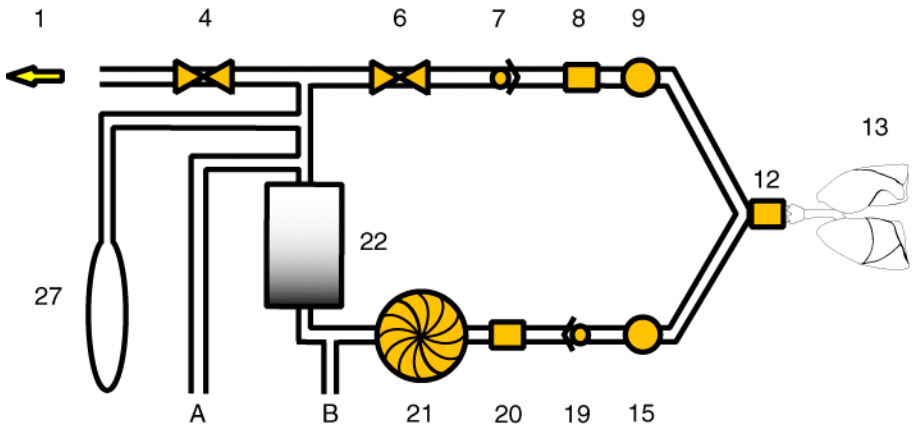

Figure 41 Breathing system, simplified view

Table 9 Legend to Figure 41

Item	Designation
A	Inlet for fresh gas or for fresh gas + saturated vapour
B	Fresh gas inlet
1	Feed into anaesthetic gas scavenging system
4	APL valve
6	Flow valve
7	Non-return valve, expiration
8	Pressure sensor, expiration
9	Flow sensor, expiration
12	Y-piece with flow sensor
13	Patient's lung
15	Flow sensor, inspiration
19	Non-return valve, inspiration
20	Pressure sensor, inspiration
21	Blower
22	Absorber
27	Breathing bag

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13 Hermes Computer with Monitor

13.1 General

13.1.1 Purpose

The Hermes system processes and visualises the parameters and process data of the Zeus anesthetic workstation. It also provides input and output interfaces for operator control of the Zeus. The Hermes system comprises a Windows-based CPCI computer with up to three display units.

13.2 CPCI computer

The CPCI computer of the Hermes system is accommodated in a closed 19-inch rack. The system interfaces of the CPCI computer are available by way of the front panel of the 19-inch rack. By way of a 5-pin “DC In” connector on the front panel the CPCI computer is connected to an external 24 V direct voltage source. The current consumption of the Hermes system is max. 3.5 A. The monitor and computer exchange data via the USB interface and the digital video interface. The CPCI computer supplies up to two monitors with the necessary operating voltage via separate power cables. The cables are connected to the “DC Out” output.

The legend to the following figure shows the default connector configuration of the Hermes computer.

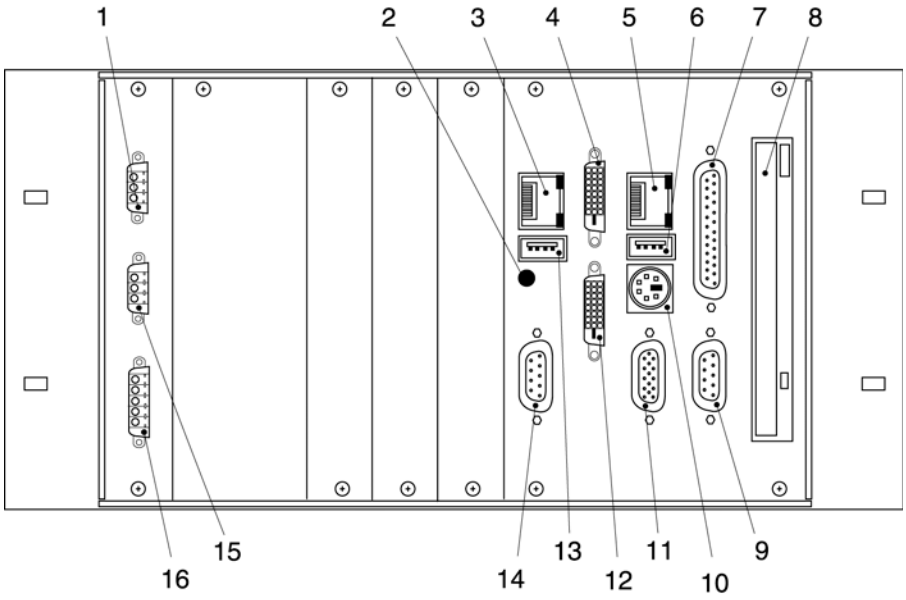

Figure 42 Rear view of Hermes

Table 10 Legend to Figure 42

Item	Name	assigned to
1	DC Out monitor 1	Supply voltage to main monitor
2	Reset button	
3	Ethernet port 1	DIANA

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Item	Name	assigned to
4	Digital video interface 1	DVI for main monitor
5	Ethernet port 2	Apollo module
6	USB port	USB for auxiliary monitor
7	Printer port	Printer
8	Floppy disk drive	
9	Serial port (COM) 2	free
10	PS/2	Mouse/keyboard
11	VGA	free
12	Digital video interface 2	DVI for auxiliary monitor
13	USB port	USB for main monitor
14	Serial port (COM) 1	Medibus/Apollo module
15	Monitor 2	Supply voltage for auxiliary monitor
16	DC in	24 V from power pack

13.3 Display screen

The Hermes system is operated by way of the monitor. Menu options and dialog boxes are selected on the touch-sensitive surface of the screen using the finger or a pen. The screen views can be changed using a turn knob on the monitor case. System functions are adapted and monitored using the keys on two membrane keypads built into the monitor case.

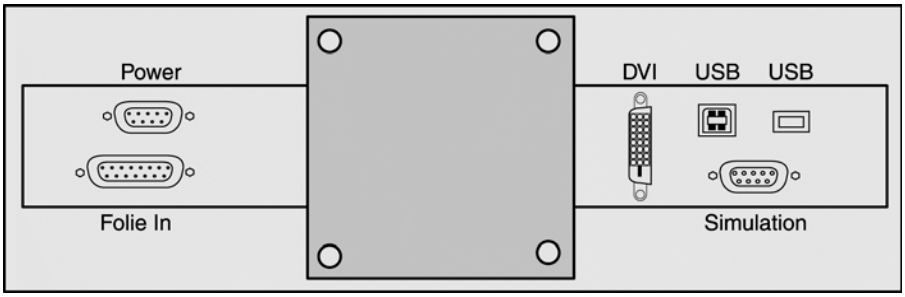

Figure 43 Monitor connections

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The main monitor is fitted with six ports, and the auxiliary monitor with five. The ports are accessible on the rear to the left and right of the monitor mount. Their functions are as follows:

– **Power:** By way of this input the monitor is supplied with the necessary operating voltage from the “DC Out” output on the CPCI computer.
– **Screen In:** By way of this port the monitor and supply system of the Zeus exchange information, such as on the readiness of the power and pipeline supply networks, the battery charge condition and on/off messages for the overall system.
– **DVI:** On the main monitor this port is connected to DVI port 1 on the CPCI computer to exchange video data. A second monitor is connected to the DVI 2 port on the CPCI computer.
– **USB:** Data and control cable
– **Simulation:** A free port on an external computer (such as a laptop) is connected to this port by a serial cable. The two devices communicate via a fixed protocol. The signals of the touch-screen, keypad and turn knob control elements can be tested independently of each other. The monitor electronics evaluate the signals and forward the data via the USB port to the CPCI computer.

If two monitors are used on the Zeus, two different modes are possible:

– **Normal mode:** The monitors display the same on-screen content.
– **Dual Video mode:** In Dual Video mode the views on each of the two monitors connected to the DVI ports combine to form one video image.

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Maintenance Procedures

1 Water trap

1.1 Replacement interval

For the replacement interval of water trap, refer to the Instructions for Use manual.

1.2 Replacing or draining the water trap

1. Pull out the water trap at the front.

Figure 1 Removing the water trap

2. Insert an empty syringe or cannula (at least 20 mL) into the connector.
3. Suck out the water (Figure 2); remove the syringe and dispose it according to applicable regulations.

Figure 2 Sucking out the water

4. Insert the water trap into the holder until it engages perceptibly.
5. Perform a functional check according to the Zeus test instructions.

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2 Blower spindle

2.1 Replacement interval

For replacement intervals of the blower spindle, refer to the Instructions for Use manual.

2.2 Replacing the blower spindle

CAUTION
Risk of damage due to sparking!
To avoid sparking, the blower may only be removed in “Standby” or with the Zeus switched off.

1. Remove the breathing system.
2. Loosen the two quick-locking screws on the blower, and remove the blower from the breathing system.
3. Unscrew the 3 socket-head cap screws on the upper part of the blower from below.
4. Remove the plate with the locking pins.
5. Unscrew the 3 socket-head cap screws on the blower cover and remove the blower cover complete with the casing top section, the sleeves and the bellows.
6. If necessary, replace the blower cover, the bushes or the bellows.
7. Lift out the blower spindles.

CAUTION
Risk of damage to the blower spindle.
In order to avoid damage to the blower spindle, handle it only by its metal housing. No foreign bodies must be allowed to enter the blower when refitting.

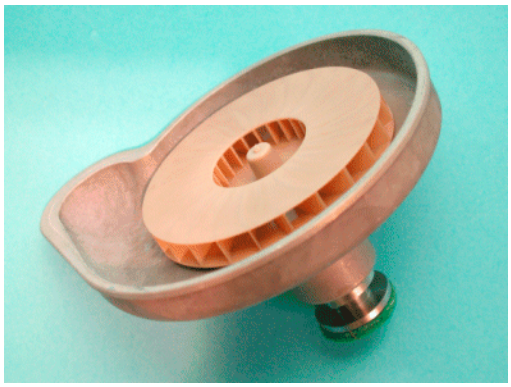

Figure 3 Blower spindle

8. Refit the blower spindles in the reverse order of their removal.
9. Attach the label (month and year of the blower replacement) to the housing of the blower drive.
10. Perform the ventilation modes function tests as per Zeus test document.

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3 Filter mat in the power supply unit

3.1 Replacement interval

For replacement intervals of the filter mat, refer to the Zeus Instructions for Use manual.

3.2 Location

The power supply unit is located on the side of the Zeus which holds the breathing system (Figure 4, dashed frame).

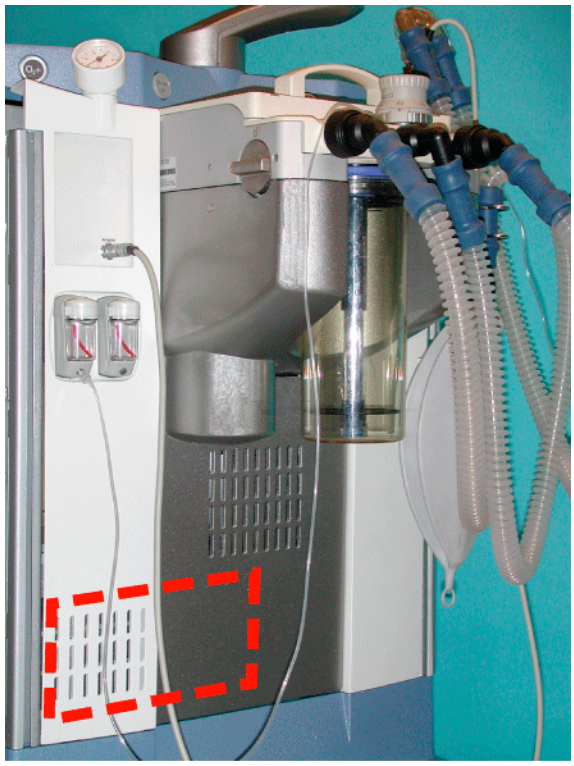

Figure 4 Fitting location of the power supply unit in the Zeus

3.3 Removing the cover

CAUTION
Risk of short circuiting during disassembly.
In order to avoid short-circuits in the device during disassembly of parts or assemblies, shut down the Zeus, set the power switch to the “OFF” position, and disconnect the Zeus from the power and gas supplies.

3.3.1 Plastic cover underneath the pneumatic interface

1. Remove the plastic cover **underneath the pneumatic interface of the breathing system** as described in the Repair Instructions"Opening the device", section 1.2.1 Plastic cover underneath the pneumatic interface.

3.4 Replacing the filter mat

The filter mat is located behind a sheet-metal frame, which must be removed in order to replace the filter mat.

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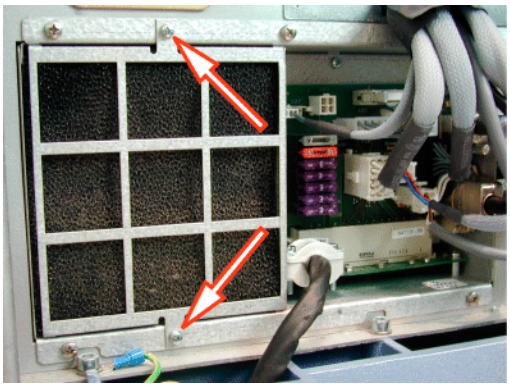

Figure 5 Frame fixing screws

1. Unscrew the fixing screws holding the frame (Figure 5).
2. Remove the frame.
3. Replace the filter mat.
4. Check the fan for proper functioning.
5. Refit the plastic covers using the reverse method of that used for removal.
6. Perform a functional check according to the Zeus test instructions.

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4 Filter mat in the GMZ

4.1 Replacement interval

For the replacement interval of the filter mat in the GMZ (Gas Measurement Module Zeus), refer to the Instructions for Use manual.

4.2 Replacing the filter mat

The GMZ is located on the side which holds the breathing system (Figure 6, dashed frame). Some parts of the plastic covering must be removed in order to be able to remove the filter mat.

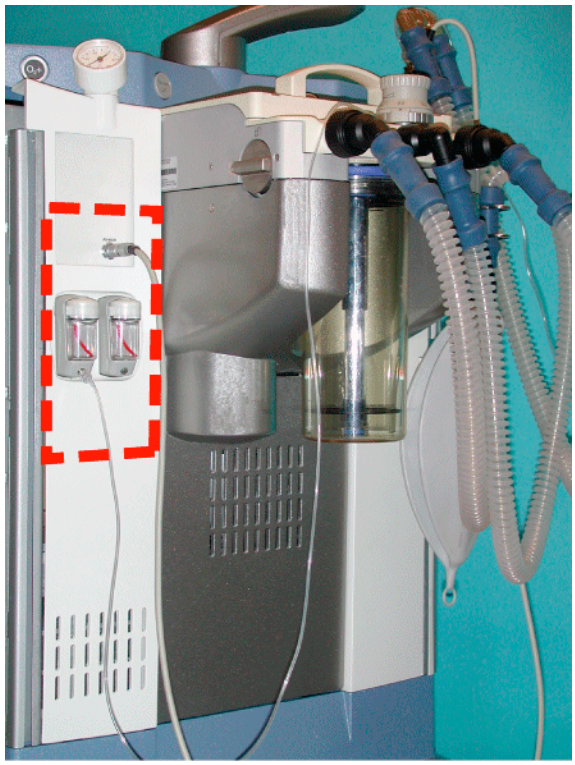

Figure 6 Fitting location of the GMZ in the Zeus

CAUTION
Risk of short circuiting during disassembly.
In order to avoid short-circuits in the device during disassembly of parts or assemblies, shut down the Zeus, set the power switch to the “OFF” position, and disconnect the Zeus from the power supply.

1. Remove the plastic cover **underneath the pneumatic interface of the breathing system** as described in the Repair Instructions"Opening the device", section 1.2.1 Plastic cover underneath the pneumatic interface.
2. Replace the filter mat (Figure 7).

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Figure 7 Filter mat (arrow) in the GMZ

3. Refit the plastic covers using the reverse method of that used for removal.
4. Perform a functional check according to the Zeus test instructions.

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5 Removing/fitting the breathing system

Components can be replaced after removing the plate at the underside of the breathing system.

1. Unscrew the 5 screws marked with arrows in Figure 8.

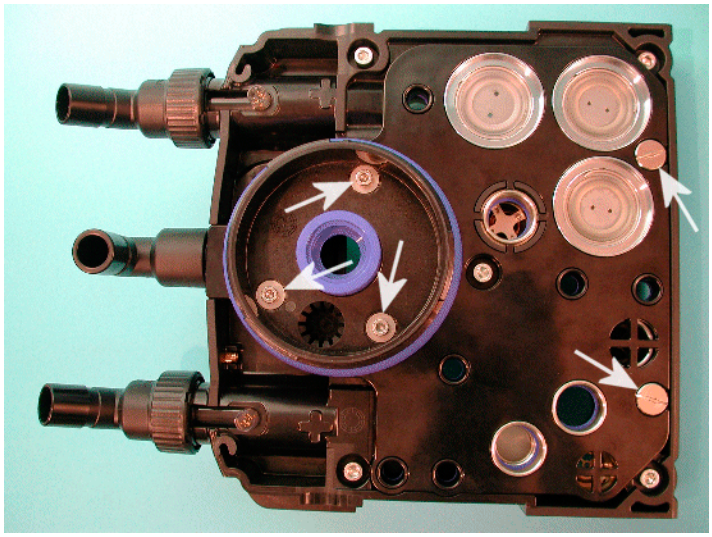

Figure 8 Plate fixing screws

2. Remove the plate.
3. Refit the breathing system using the reverse order of that used for removal.
4. Perform a functional check according to the Zeus test instructions.

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6 Diaphragm mounts in the breathing system

6.1 Replacement interval

Refer to the Zeus Instructions for Use manual for the replacement intervals of the flow, Spont, and Closed valve diaphragm mounts.

6.2 Removing the breathing system

1. Remove the breathing system as described in the chapter Maintenance Procedures, Removing/Fitting the Breathing System.

6.3 Replacing the diaphragm mount

The flow valve (Figure 9-6) and the Spont valve (Figure 9-5) are valves the diaphragms of which seal against a crater. The diaphragm of the Closed valve (Figure 9-3) actuates a valve insert.

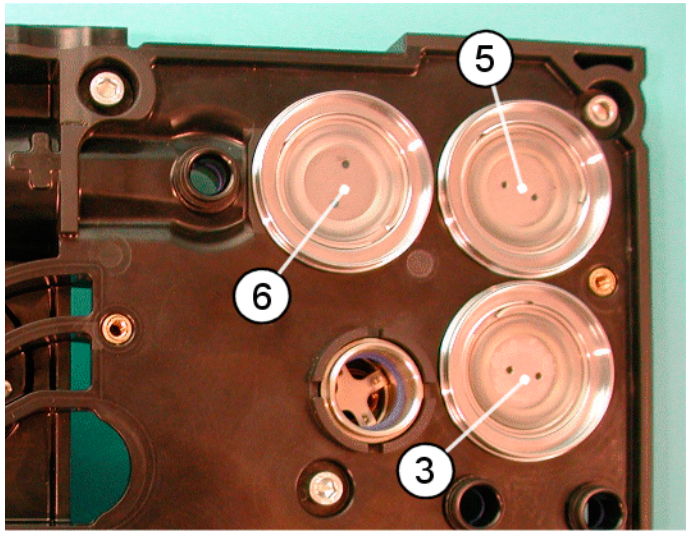

Figure 9 Flow (6), Spont (5), and Closed valve (3), old version

NOTE
The diaphragm mount has been redesigned for leakage reasons. **In the event of maintenance**, replace all old metal diaphragm mounts with the new diaphragm mounts made of black plastic.
Only in the event of repair may those metal diaphragm mounts that are still intact remain in the breathing system. Only the faulty diaphragm mount is replaced with the new type made of plastic.

Removing the metal diaphragm mount

1. Remove the retaining ring and the washer underneath from the respective diaphragm mount (Figure 9).
2. Remove the diaphragm.
3. Pull the diaphragm mount out of the breathing system and discard it.
4. Continue with step 6.

Replacing the plastic diaphragm mount

5. Pull the diaphragm mount out of the breathing system and discard it.

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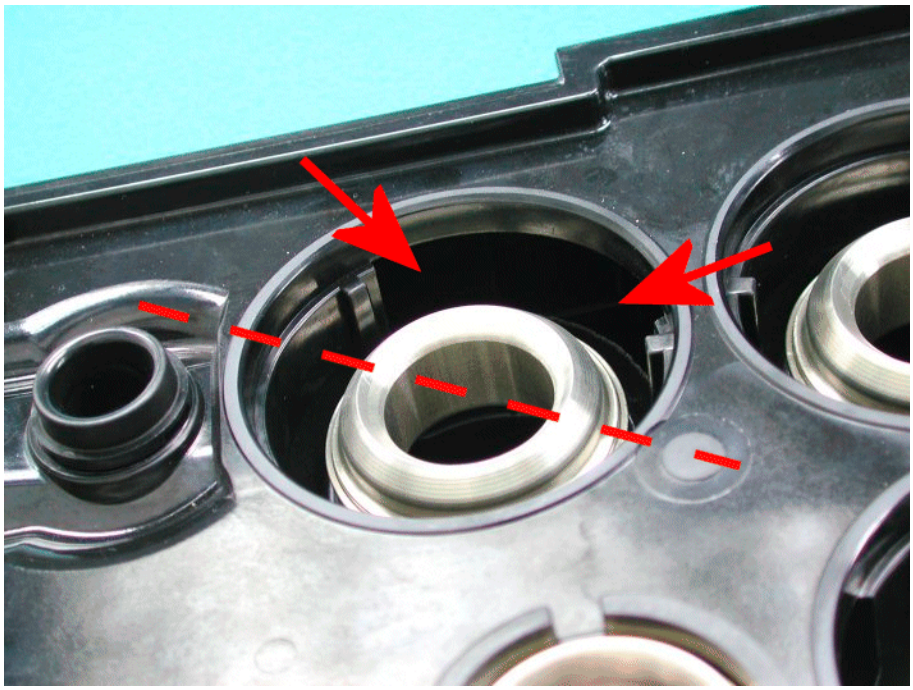

Figure 10 Diaphragm mount location hole

NOTE
Observe the preferred position of the diaphragm mount.
The location holes for the diaphragm mounts have a large gap on each side (see arrows in Figure 10). To keep the flow resistance low, these gaps must not be covered by the diaphragm mount segments (see arrows in Figure 11). When fitting the diaphragm mount, position the diaphragm mount segments such that they are in line with the (imaginary) dashed line shown in Figure 10.

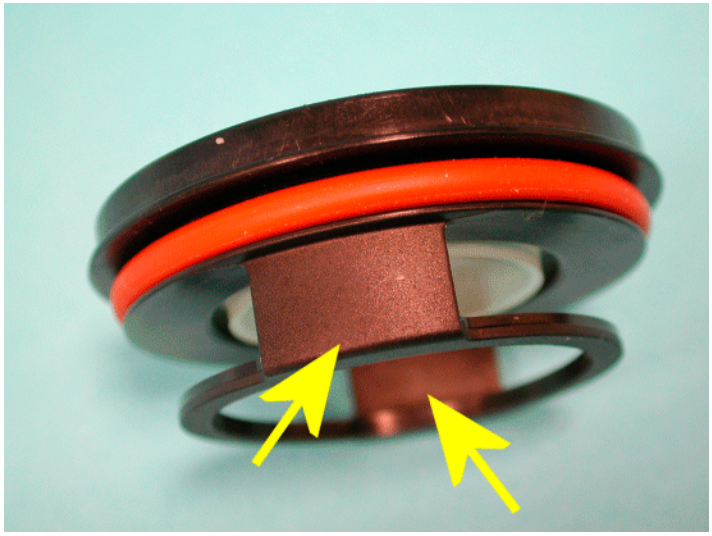

Figure 11 Diaphragm mount segments

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6. Fit the new diaphragm mount into the breathing system making sure it is aligned properly (preferred position).

6.4 Fitting the breathing system

1. Fit the breathing system as described in the chapter Maintenance Procedures, Removing/Fitting the Breathing System.
2. Perform a functional test as per Zeus test documentation.

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7 Flow sensor “SpiroLife” in the breathing system

7.1 Replacement interval

For the replacement interval of the “SpiroLife” flow sensor, refer to the Zeus Instructions for Use manual.

7.2 Replacing the “SpiroLife” flow sensor

1. Unscrew the inspiratory hose connection (←) and/or the expiratory hose connection (→).
2. Unlock the breathing system at the two lateral turn-locks.
3. Lift the breathing system at the handle and remove.
4. Remove the “SpiroLife” flow sensor (Figure 12) and replace it with a new one.

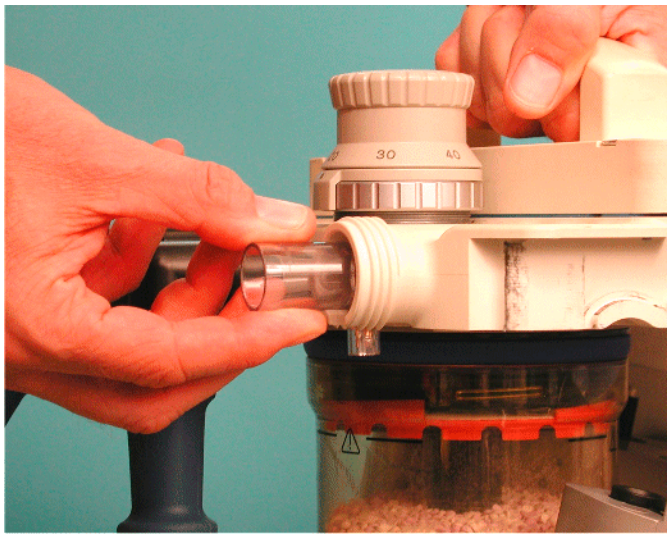

Figure 12 Removing the flow sensor

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8 Sampling-gas return-line filter

The sampling-gas return-line filter is replaced at regular intervals as a preventive measure.

8.1 Replacement interval

For replacement intervals of the sampling-gas return-line filter, refer to the Zeus test documentation.

8.2 Replacing the filter

1. Remove the breathing system.
2. Remove the plastic cover **underneath the pneumatic interface of the breathing system** (remove screws on left and right)

The filter (shown by an arrow in Figure 13) is connected to a micro-solenoid valve on the Pressure/Flow PCB via a reducer and a thin tube.

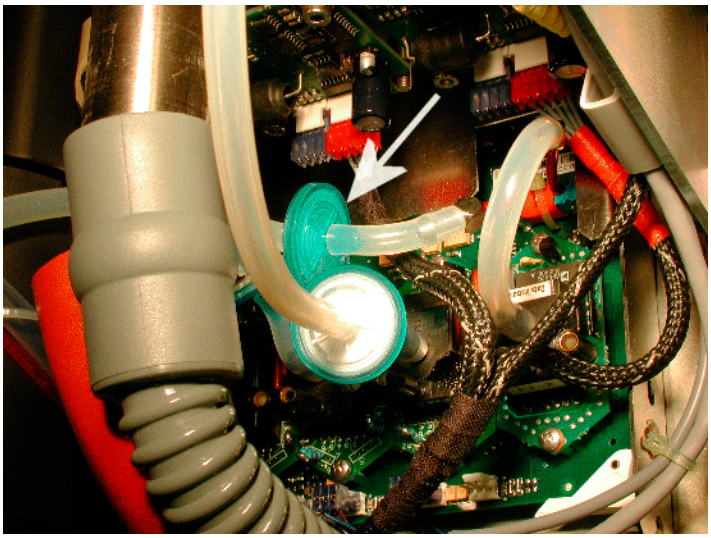

Figure 13 Sampling-gas return-line filter

3. Disconnect the filter (shown by an arrow) from the tubes and replace it with a new one.
4. Refit using the reverse order of that used for removal.
5. Perform a functional test as per Zeus test documentation.

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9 Sintered-metal filters of the CS connections

9.1 Replacement interval

For replacement intervals of the sintered-metal filter, refer to the Zeus Instructions for Use manual.

9.2 Replacing the sintered-metal filters

The following steps can be carried out with the CS module fitted.

On the underside of the gas inlet block are the NIST connections (Figure 14/1) of the pipeline supply gases and of the N2O/O2 compressed gas cylinders (Figure 14/2).

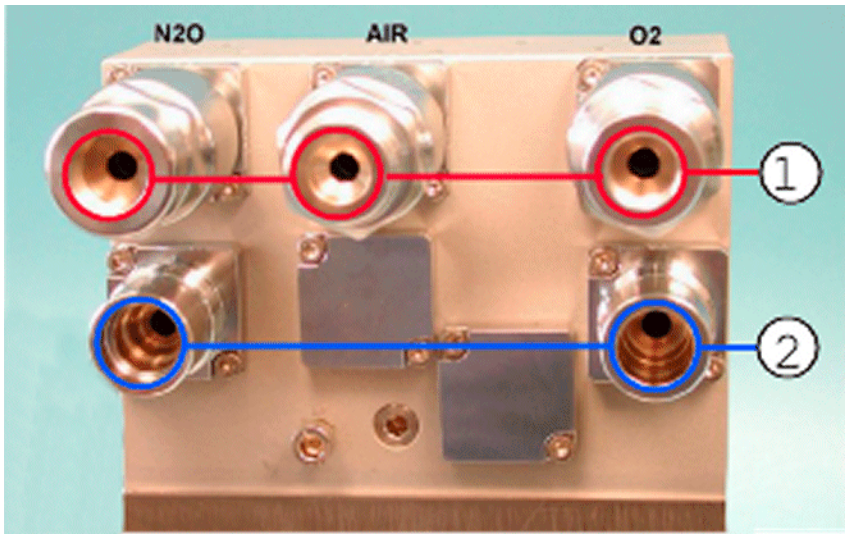

Figure 14 Assignment of connections

The following procedure for removal and refitting (based on the example of the NIST connection for O2) applies correspondingly to all NIST connections.

1. Depressurize the unit.

CAUTION
Possibility of NIST connections being swapped.
If all NIST connections are removed at the same time there is a risk that they might be swapped upon reassembly. To avoid mixing up the connections, remove and refit each connection individually before starting with the next one.

2. Remove the two fixing screws of the NIST connection for O2.
3. Unscrew the sintered-metal filter of the O2 NIST connection by turning it counter-clockwise (see Figure 15).

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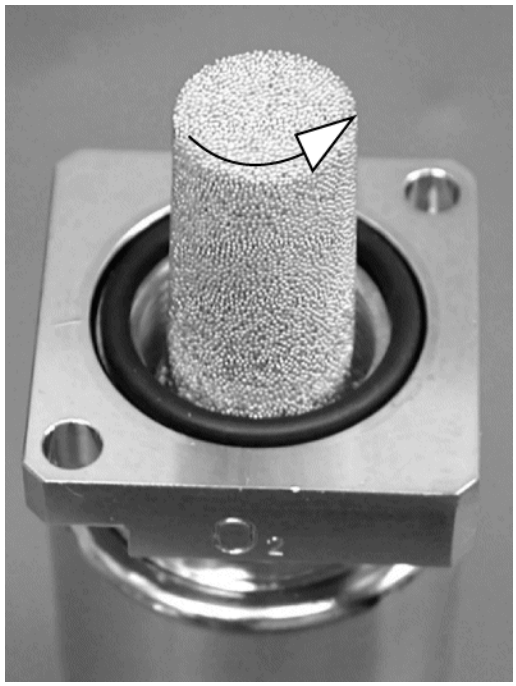

Figure 15 Sintered filter

4. Screw in the new sintered-metal filter of the O2 NIST connection hand-tight.
5. Check that the O-ring on the NIST connection is undamaged and replace it as necessary.
6. Screw in the two fixing screws of the NIST connection for O2. Make sure the O-ring is not trapped.
7. Replace the other sintered-metal filters one after the other.
8. Check that the marking on the gas inlet matches the marking on the fitted NIST connections (see Figure 16). The marking also applies to the cylinder connections for N2O and O2 on the second line.

Figure 16 NIST and cylinder connection markings

9. Carry out leak test and gas-type test as per test instructions.

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10 Pressure regulators on the gas inlet block

The gas inlet block is a subassembly of the CS module. The gas inlet block holds the inlet pressure regulators for the gases O2, N2O, and Air. The pressure regulators are replaced during the maintenance procedures.
The following procedure describes how to replace the pressure regulators with the CS module being completely removed. However, if done correctly, instead of removing the CS module you can also pull it out only so far that you can easily access and then replace the pressure regulators.

10.1 Replacement interval

For replacement intervals of the pressure regulators on the gas inlet block, refer to the Instructions for Use manual.

10.2 Location

In order to replace the pressure regulators, you need to remove the CS module. The CS module is fitted on the side of the Zeus on which the reserve gas cylinders are also located.

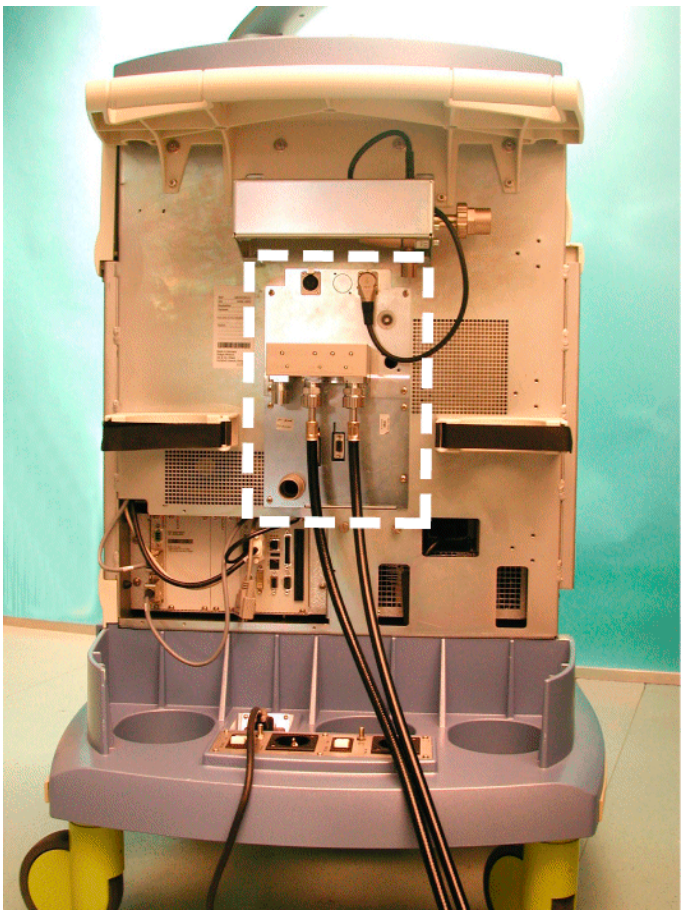

Figure 17 CS module fitting location

10.3 Disassembly

1. If fitted, remove the compressed gas connections and connectors of the high-pressure sensors.
2. Remove the fixing screws from the module (see arrows on Figure 18).

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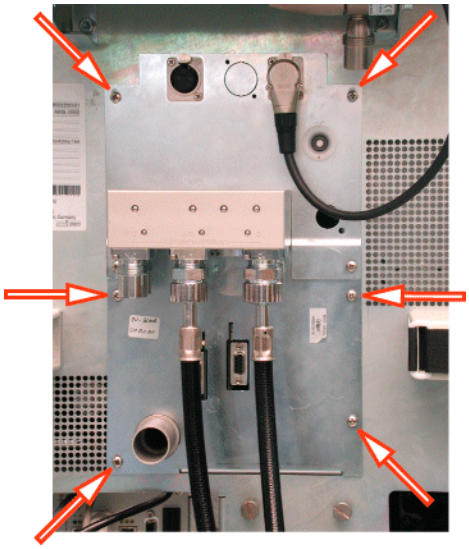

Figure 18 CS module fixing screws

3. Withdraw the CS module far enough for the connectors and tubes to be easily accessible but not so far as to pull it out of the Zeus.
4. Cut the heat-shrink tubing at the power switch in the area of the lock nut, as shown in Figure 19.
5. Loosen the lock nut (Figure 19) and unscrew the power switch.

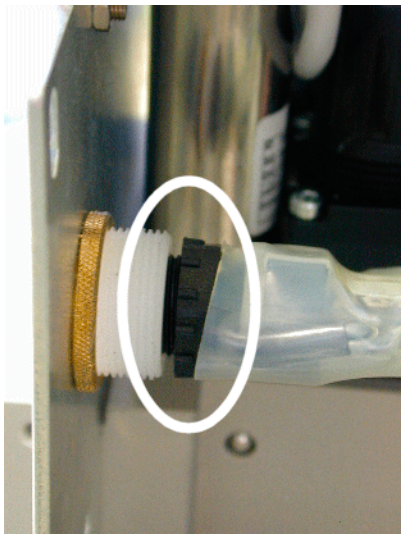

Figure 19 Power switch with lock nut

CAUTION
Risk of mixing up the white hoses on the valve block.
The two white hoses on the valve can be mixed up during assembly.
Before disconnecting the hoses, mark them to avoid mixing them up upon later reassembly.

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6. Disconnect all hoses from the valve block (Figure 20).

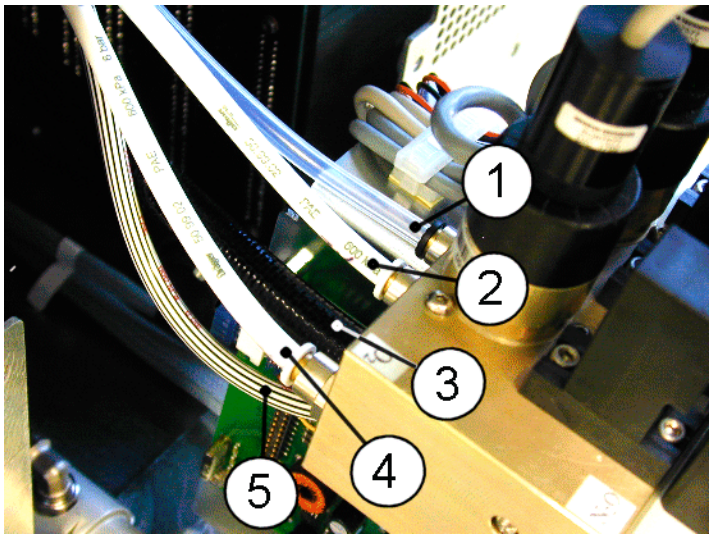

Figure 20 Allocation of the hoses

Table 1

Item	Designation, color
1	Carrier gas (AIR or N2O) from mixer to DIVA supply module, transparent hose(s)
2	O2 from mixer to DIVA supply module, white hose(s)
3	AIR connecting hose of secretion suction device, black hose(s)
4	Safety O2 to O2 flush and to emergency flow control, white hose(s)
5	AIR to DIVA supply module, black-white striped hose(s)

7. Unplug the fan connector from the CS Pressure PCB (on the left side of the CS module).
8. Detach the central connector to the Zeus on the DAGMAR PCB (on the right side of the CS module).
9. Withdraw the CS module completely from the Zeus.

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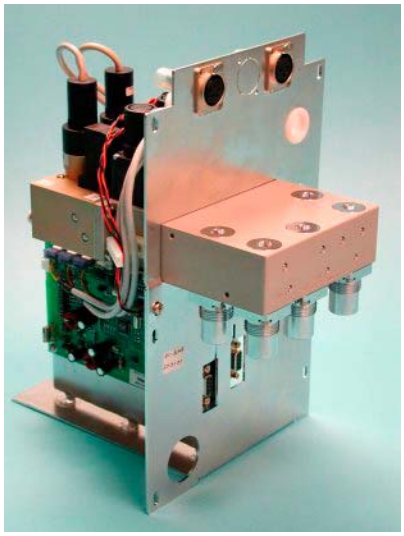

Figure 21 CS module complete

10.4 Replacing the pressure regulators

1. Unplug the connectors of the two sockets to connect the high-pressure sensors on the CS Pressure PCB and take the cable out of the cable clamp.
2. Underneath the gas inlet block at the left and right unscrew the two screws from the panel and move the upper panel of the CS module aside.

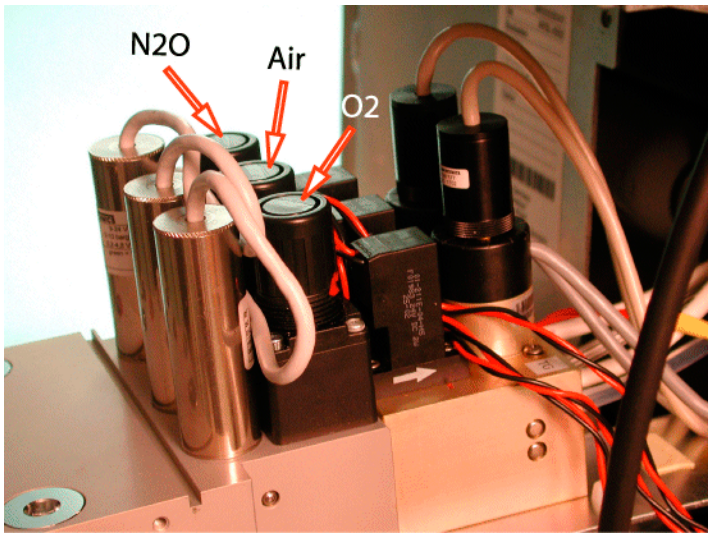

Figure 22 Assignment of pressure regulators

3. Unscrew the two **hex socket screws** of the relevant pressure regulator and remove it.

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CAUTION
Risk of leakages due to incorrectly fitted O-rings.
The pressure regulators are sealed with O-rings at the interface to the gas inlet block. When fitting the pressure regulators, make sure the two O-rings underneath the pressure regulators do not slip or fall off!

4. Provide the pressure regulators with two new O-rings each.

CAUTION
Malfunction due to incorrectly fitted pressure regulators.
If the pressure regulators are offset by 180 degrees they will not supply any gas. Fit the pressure regulators in their predominant position!

5. Place the respective pressure regulator onto the gas inlet block such that the arrow on the pressure regulator points in the same direction as the arrow on the gas inlet block (from the inlet to the outlet in each case, see also Figure 23). The inlet and the outlet are also marked on the underside of the pressure regulator (1 = inlet, 2 = outlet).

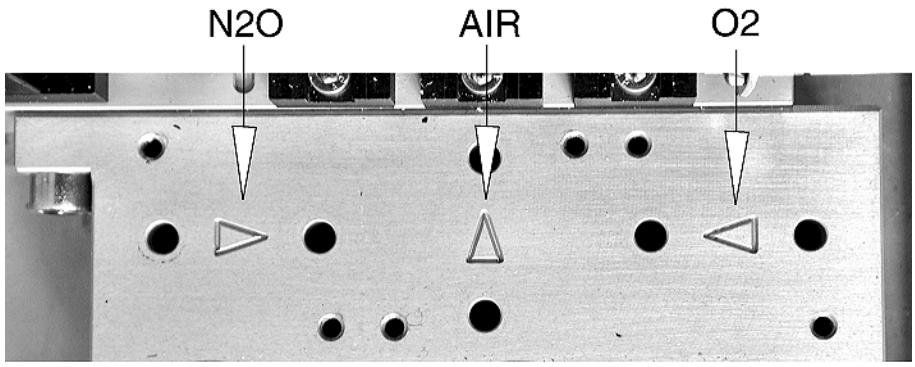

Figure 23 Predominant position of the pressure regulators

6. Before the CS module is fitted in the Zeus, the pressure regulator must be adjusted as per the test document. To do so, pull up the circular cap of the pressure regulator (to unlock it) and adjust the pressure by turning the cap. Then push the cap back down to lock it.
7. Reassemble using the reverse order of disassembly.
8. Perform the function test on Zeus as per test instructions.

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11 Batteries of the uninterruptible power supply

NOTE
Batteries represent special waste. Batteries must be disposed of in conformity with local waste disposal regulations.

11.1 Replacement interval

For replacement intervals of the Zeus rechargeable batteries, refer to the Instructions for Use manual.

11.2 Location

The rechargeable batteries for the uninterruptible power supply are located underneath the trolley in a drawer. Before replacing the rechargeable batteries, check if the fuse (Figure 24/1) is OK.

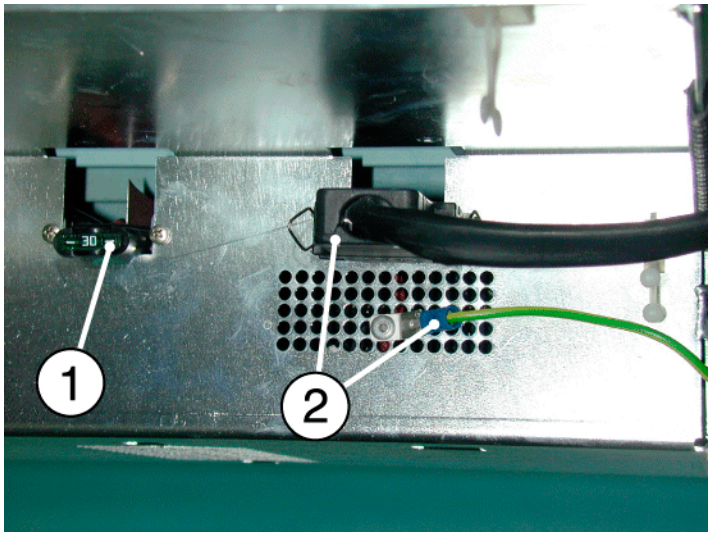

Figure 24 Fuse (1) and connector (2) on drawer unit

11.3 Replacing the rechargeable batteries

CAUTION
Risk of short circuiting during disassembly/assembly.
In order to avoid short-circuits in the device during disassembly of parts or assemblies, shut down the Zeus, set the power switch to the “OFF” position, and disconnect the Zeus from the power and gas supplies.

1. On the rear of the Zeus underneath the trolley, detach the PE conductor and the connector (Figure 24/2) from the rechargeable batteries' drawer.
2. Unscrew the hexagon socket screws in the trolley foot in the area of the blue drawer (1 each at the front and rear).
3. Hold the cables out slightly and withdraw the drawer for the rechargeable batteries.

CAUTION
Risk of short circuiting during disassembly/assembly.
To avoid shorting when detaching/attaching the cables, disconnect the cable connecting the two rechargeable batteries first upon disassembly and reconnect it last upon reassembly.

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4. Disconnect the connecting cables (Figure 25/2).

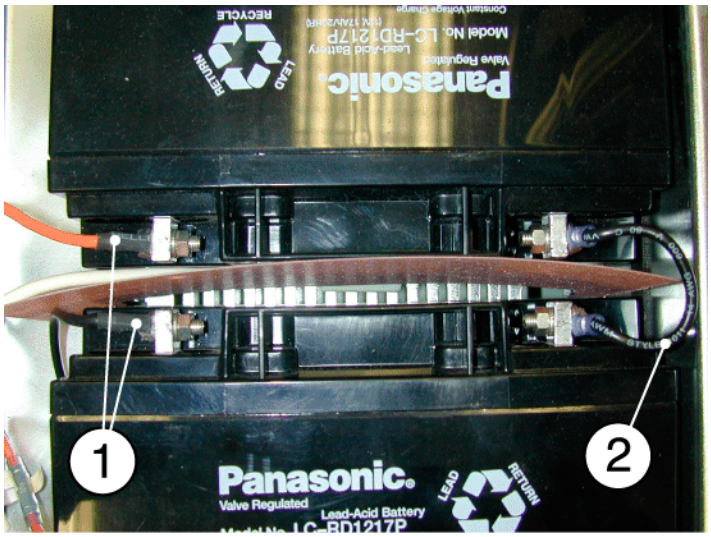

Figure 25 Connecting the rechargeable batteries

5. Unscrew the leads (Figure 25/1) and remove the rechargeable batteries.

CAUTION
Overheating of the rechargeable batteries.
In order to avoid overheating the rechargeable batteries during charging, the charging cycle is controlled by a temperature sensor. To ensure proper operation, the temperature sensor must be placed between the two rechargeable batteries upon reassembly.

6. Refit the rechargeable batteries in the reverse order of their removal.
7. Perform a function test of the uninterruptible power supply as per test instructions.

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Schematics and Diagrams

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1 Schematics and diagrams

This section contains schematics and diagrams to the Zeus, e.g. the pneumatics or tubing diagram. These schematics and diagrams are partly used as reference to the function description.

NOTE
The legend to the pneumatics diagram is subdivided into assemblies which are identified by numbers, e.g. “1 Pipeline plug-in module”, “2 DIVA”, “3 Breathing system” etc. In the pneumatic diagram, the assemblies are identified by the bold number within the dashed frame, i.e. “1” stands for “Pipeline plug-in module”, “2” for “DIVA”, “3” for “Breathing system” etc.

NOTE
Part numbers shown in the illustrations are for identification purposes only; this does not necessarily mean that these items can be ordered. To order spare parts, use the relevant parts catalog only!

NOTE
Some of the following illustrations are not available in other languages.

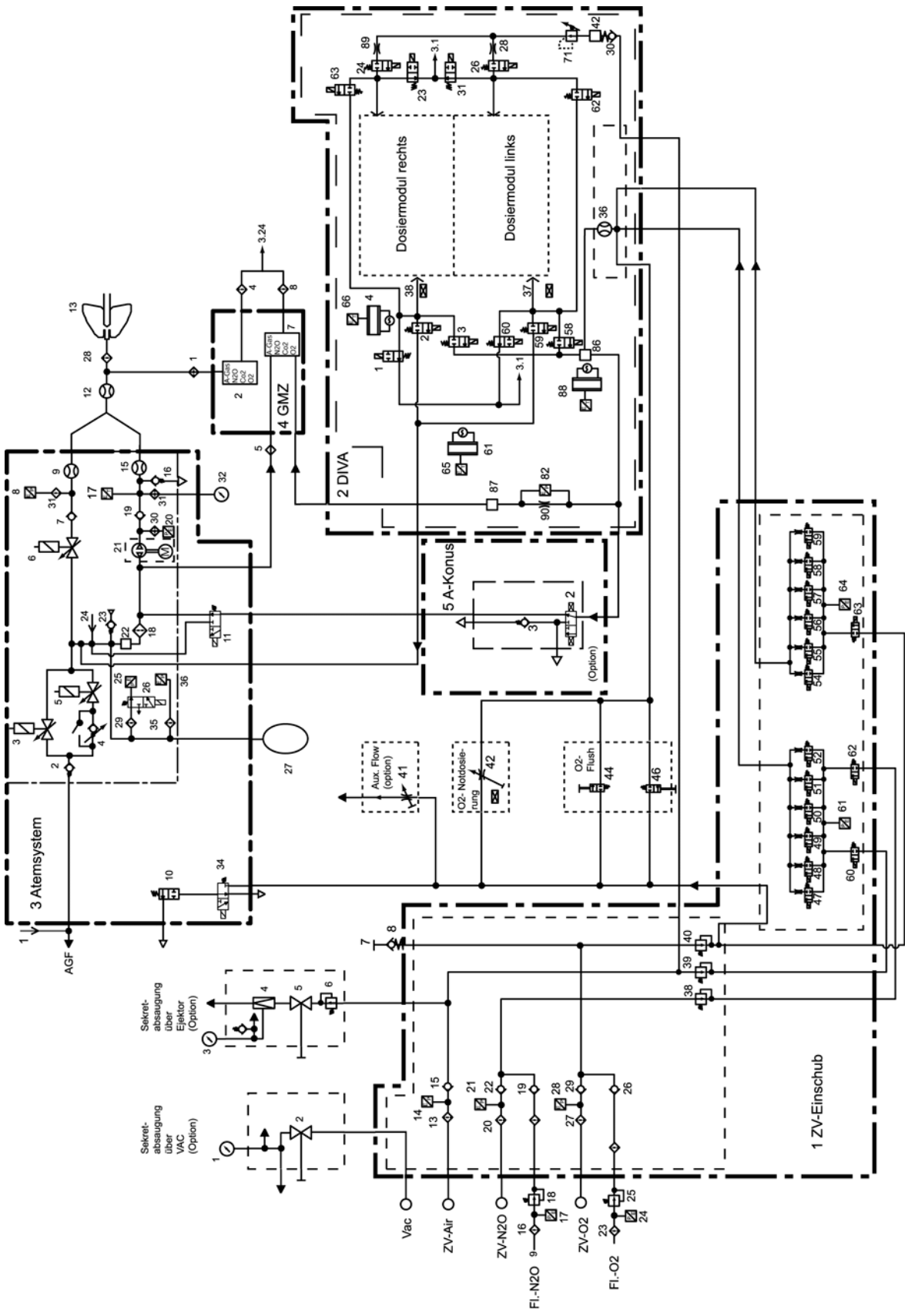

Figure 1 Zeus pneumatics diagram, RI 25

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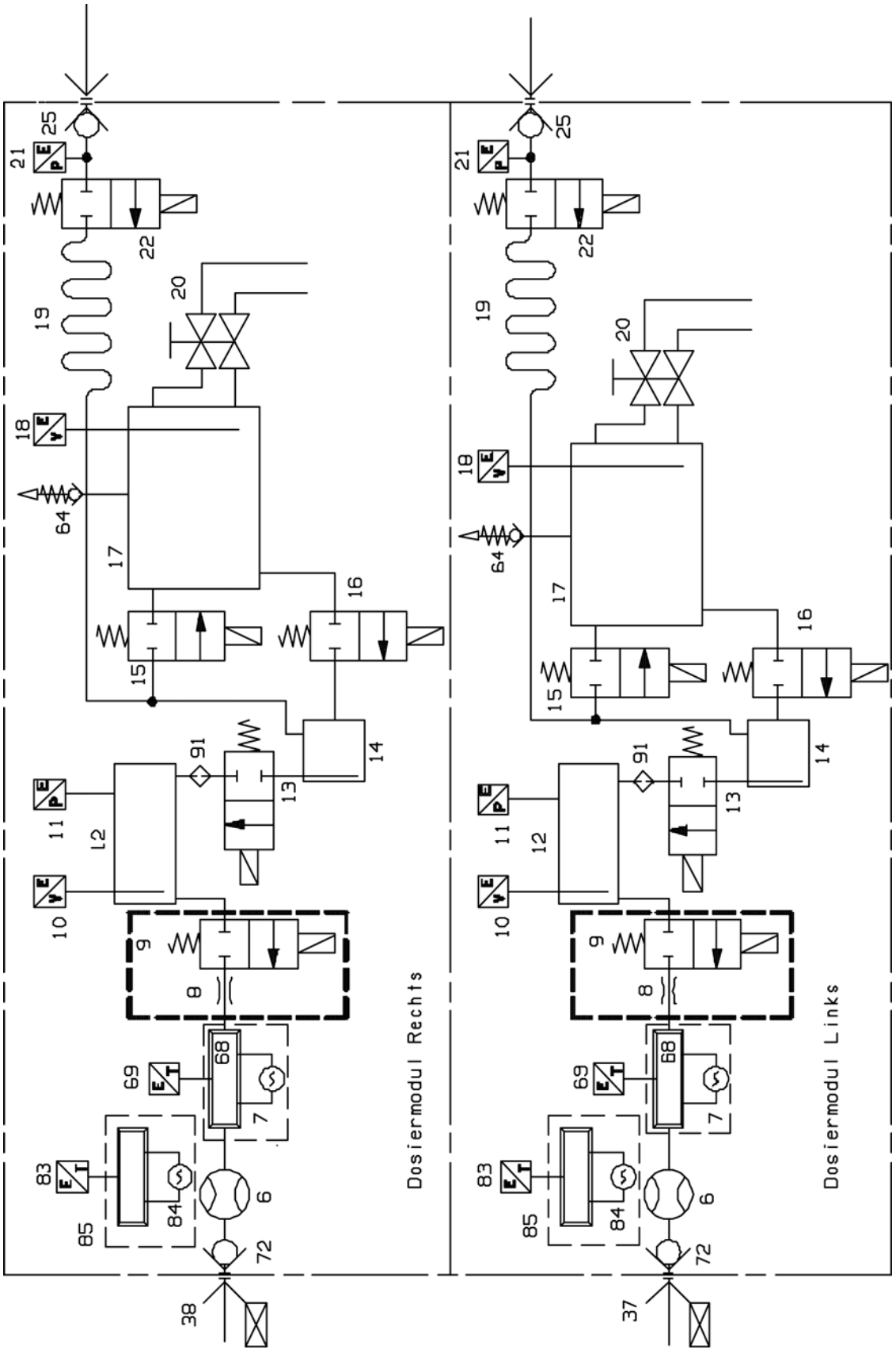

Figure 2 Dosage module pneumatics diagram, RI 25

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Legend to Figure 1**and**Figure 2

1 Pipeline plug-in module

1. 1	Low pressure display of secretion suction device VAC	1.29	O2 pipeline non-return valve
1. 2	Bypass valve VAC	1.30	Not assigned
1. 3	Low pressure display of secretion suction device AIR	1.31	Not assigned
1. 4	Ejector	1.32	Not assigned
1. 5	Bypass valve AIR	1.33	Not assigned
1. 6	Pressure regulator of secretion suction device	1.34	Not assigned
1. 7	Auxiliary O2 connection	1.35	Not assigned
1. 8	Auxiliary O2 locking coupling	1.36	Not assigned
1. 9	N2O cylinder inlet	1.37	Not assigned
1.10	AIR cylinder inlet	1.38	N2O supply pressure regulator
1.11	Not assigned	1.39	AIR supply pressure regulator
1.12	Not assigned	1.40	O2 supply pressure regulator
1.13	AIR pipeline inlet filter	1.41	Aux. O2 flow control
1.14	AIR pipeline pressure sensor	1.42	Safety flow control
1.15	AIR pipeline non-return valve	1.43	Not assigned
1.16	N2O cylinder inlet filter	1.44	O2 flush, left
1.17	N2O cylinder pressure sensor	1.45	Not assigned
1.18	N2O cylinder pressure regulator	1.46	O2 flush, right
1.19	N2O cylinder non-return valve	1.47	Carrier gas digital valve 0.75
1.20	N2O pipeline inlet filter	1.48	Carrier gas digital valve 1.5
1.21	N2O CS pressure sensor	1.49	Carrier gas digital valve 3.0
1.22	N2O pipeline non-return valve	1.50	Carrier gas digital valve 6.0
1.23	O2 cylinder inlet filter	1.51	Carrier gas digital valve 9.0
1.24	O2 cylinder pressure sensor	1.52	Carrier gas digital valve clock
1.25	O2 cylinder pressure regulator	1.53	Not assigned
1.26	O2 cylinder non-return valve	1.54	O2 digital valve 0.75
1.27	O2 pipeline inlet filter	1.55	O2 digital valve 1.5
1.28	O2 CS pressure sensor	1.56	O2 digital valve 3.0

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1.57 O2 digital valve 6.0
1.58 O2 digital valve 9.0
1.59 Digital valve clock
1.60 Air switching valve
1.61 Carrier gas supply pressure sensor
1.62 N2O switching valve
1.63 O2 switching valve
1.64 O2 supply pressure sensor

2 DIVA

2. 1 AGS valve, right
2. 2 Saturated-vapor valve, right
2. 3 Fresh-gas valve, right
2. 4 Distributor block heater
2. 5 Not assigned
2. 6 DUMA sensor
2. 7 Vaporizer chamber
2. 8 Injection valve screen
2. 9 Flow control valve
2.10 Dosage tank fill level sensor
2.11 Dosage pressure sensor
2.12 Dosage tank
2.13 Refill tank
2.14 Pump tank
2.15 Tank vent valve
2.16 Tank outlet valve
2.17 Storage tank
2.18 Storage tank fill level sensor
2.19 Buffer volume
2.20 Filling system
2.21 Supply pressure sensor
2.22 Supply pressure valve
2.23 Pressure-relief valve, right
2.24 Supply valve, right
2.25 AIR opening valve
2.26 Supply valve, left
2.27 Locking coupling
2.28 Screen
2.29 Pressure supply safety valve
2.30 Check valve
2.31 Pressure-relief valve, left
2.32 Shutoff valve
2.36 Flow sensor
2.37 Locking sensor, left
2.38 Locking sensor, right
2.41 Not assigned
2.42 Buffer volume
2.58 Fresh-gas valve, left
2.59 Saturated-vapor valve, left
2.60 AGS valve, left
2.61 Saturated-vapor line heater
2.62 Test valve, left
2.63 Test valve, right
2.64 Pressure-limiting valve
2.65 Saturated-vapor line temperature sensors
2.66 Distribution block temperature sensors
2.67 Not assigned
2.68 Vaporizer chamber heater
2.69 Vaporizer chamber temperature sensors
2.70 Not assigned

2.71 Pressure regulator
2.72 Saturated vapor opening valve
2.82 SGA MOPS
2.83 Temperature sensors superheater
2.84 Overheater
2.85 Overheater
2.86 MIxing chamber
2.87 SGA MOPS volume
2.88 Mixed-volume heater
2.89 Screen
2.90 SGA MOPS screen
2.91 Particle filter

3 Breathing system

3. 1 Inlet into AGS
3. 2 AGS non-return valve
3. 3 Closed valve
3. 4 APL valve
3. 5 Spont valve
3. 6 Flow valve
3. 7 Expiratory non-return valve
3. 8 Expiration pressure sensor
3. 9 Expiratory flow sensor
3.10 Closing valve power-on test
3.11 Fresh-gas switching valve
3.12 Y-piece flow sensor
3.13 Patient
3.14 Not assigned
3.15 Inspiratory flow sensor
3.16 Respiratory gas safety valve
3.17 Respiratory gas temperature sensor
3.18 Internal microbial filter
3.19 Inspiratory non-return valve
3.20 Inspiratory pressure sensor
3.21 Blower
3.22 Absorber
3.23 Auxiliary air valve
3.24 Inlet into sampling gas return line
3.25 Breathing bag pressure sensor
3.26 Calibration valve
3.27 Breathing bag
3.28 Patient-side filter
3.29 Breathing bag pressure sensor filter
3.30 Inspiratory pressure sensor filter
3.31 Expiratory pressure sensor filter
3.32 Pressure gauge
3.33 Pressure gauge filter
3.34 Control valve for closing valve power-on test
3.35 Manual ventilation pressure sensor filter
3.36 Manual ventilation pressure sensor

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4 GMZ

4. 1 Water trap PGA
4. 2 PGA
4. 3 Not assigned
4. 4 PGA outlet filter
4. 5 Water trap SGA
4. 6 Not assigned
4. 7 SGA
4. 8 SGA outlet filter

5 A-cone

5. 1 A-cone pressure sensor
5. 2 Fresh-gas switching valve
5. 3 A-cone safety valve
5. 4 Not assigned
5. 5 Not assigned
5. 6 Not assigned

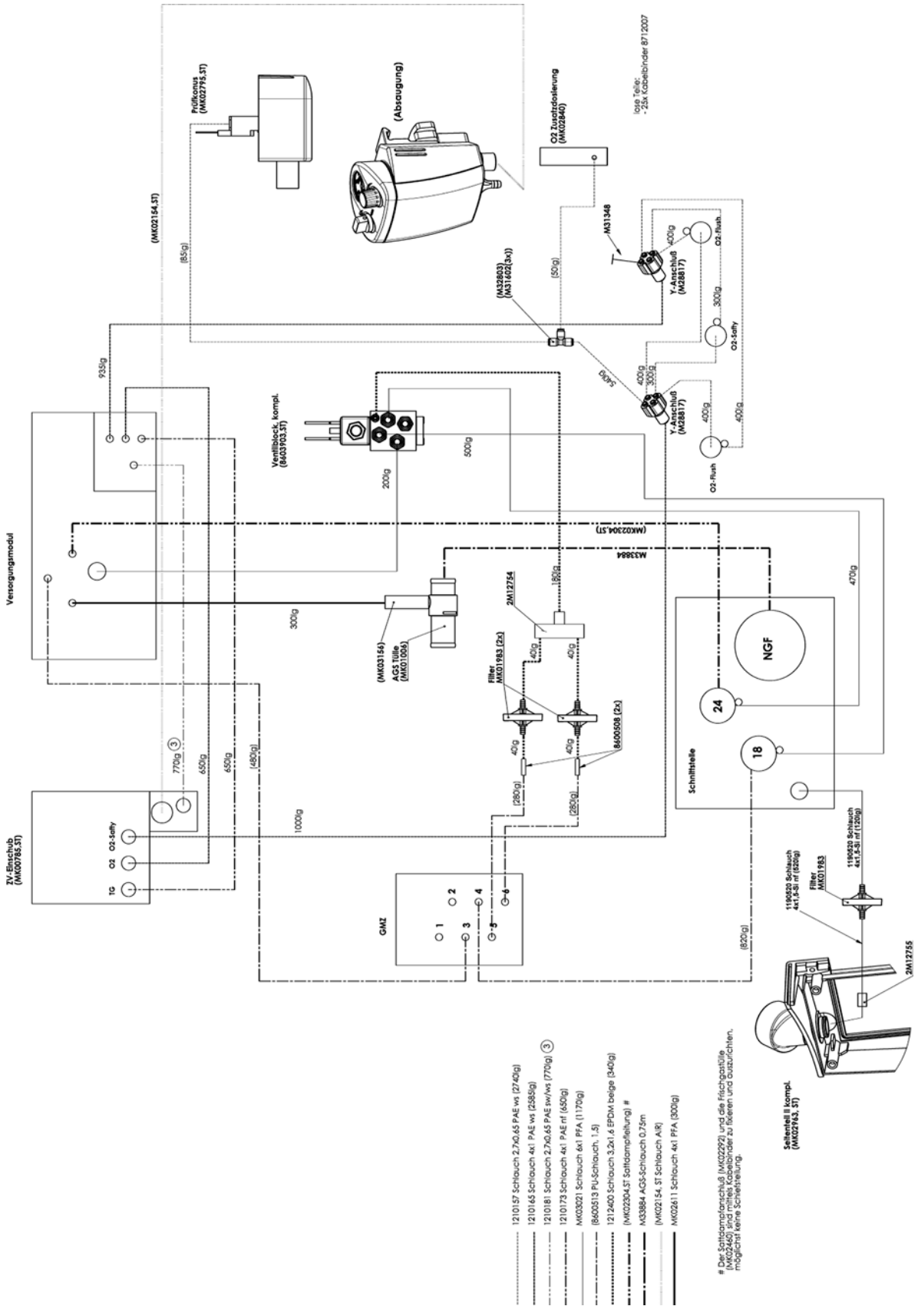

Figure 3 Tubing diagram

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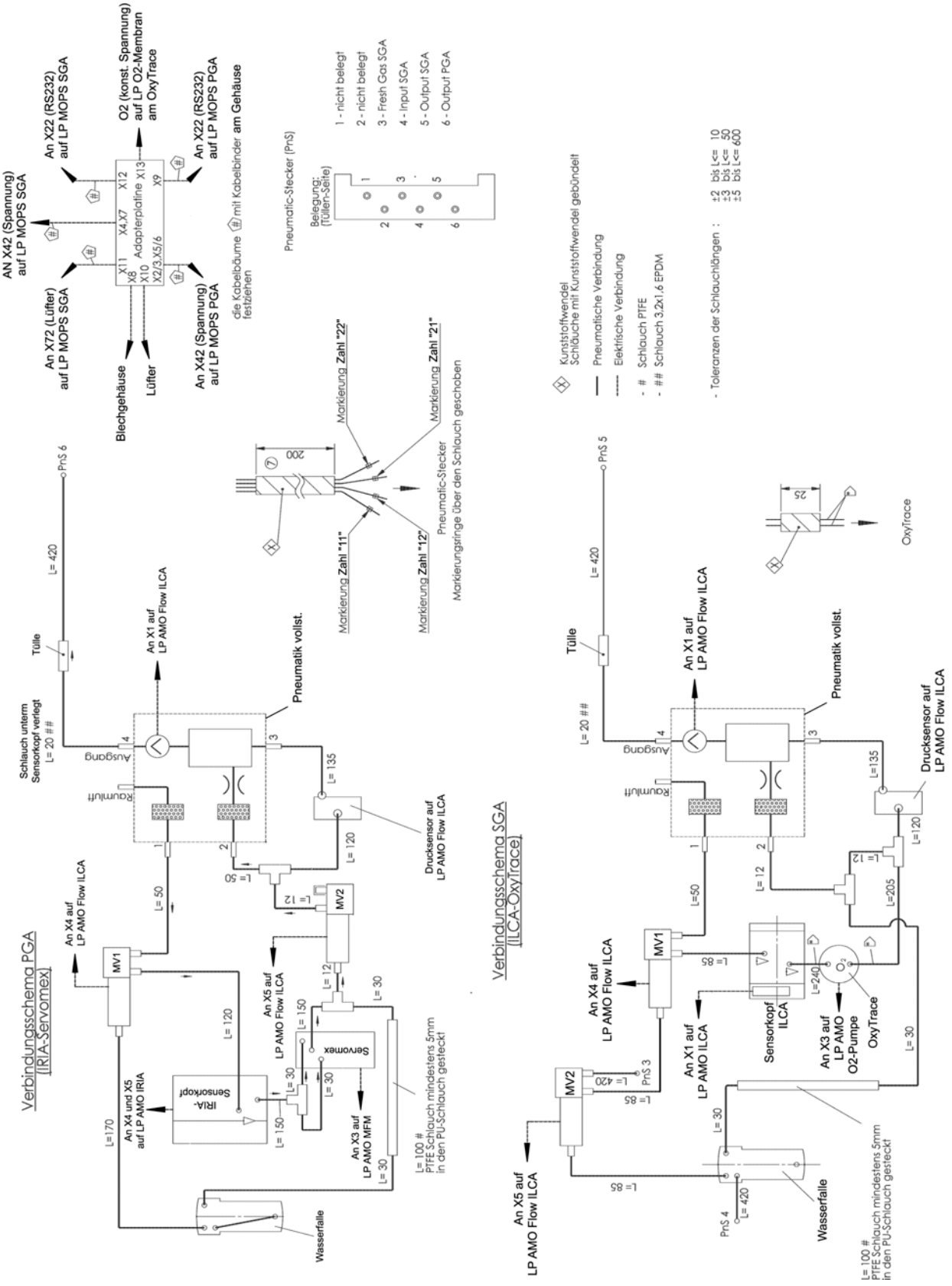

Figure 4 GMZ tubing diagram

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Annex

Technical Documentation acc. to EMV standard IEC/EN 60601-1-2: 2001

Test List

Spare Parts Catalogue

Dräger medical
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October, 30 2004

Technical Documentation for Zeus® Anaesthesia Workstation System according to EMC standard IEC/EN 60601-1-2: 2001

General Information

The EMC conformity of the Zeus® Anaesthesia Workstation System includes the use of external cables, transducers and accessories that are listed in the Zeus® List of Assessories (German: order-no. MK02818 RI 06 or greater; English: order-no. MK01159 RI 02 or greater).

Additionally, accessories may be used which do not affect EMC compliance, if no other reasons (see reference to list of accessories in the IfU) interdict the use of them. The non-observance may result in increased emissions or decreased immunity of the equipment.

The Zeus® Anaesthesia Workstation System should not be used adjacent to or stacked with other equipment; if adjacent or stacked use is inevitable, the Zeus® Anaesthesia Workstation System should be observed to verify normal operation in the configuration in which it will be used.
Other equipment which can be used adjacent to or stacked with this device are listed in Zeus® List of Accessories or if a EC Declaration of Compatibility is available by Dräger Medical.

Electromagnetic Emissions

Electromagnetic Emissions		
The Zeus® Anaesthesia Workstation System is intended for use in the electromagnetic environment specified below. The user of the Zeus® Anaesthesia Workstation System should assure that is used in such an environment.		
Emissions	**Compliance according to**	**Electromagnetic environment**
RF emissions (CISPR 11)	Group 1	The Zeus® Anaesthesia Workstation System uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
	Class A	The Zeus® Anaesthesia Workstation System is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions (IEC 61000-3-2)	Not applicable	N/A if RF emissions are class A
Voltage fluctuations / flicker (IEC 61000-3-3)	Not applicable	N/A if RF emissions are class A

Information re electromagnetic emissions (IEC 60101-1-2: 2001, table 201)

Electromagnetic Immunity

Electromagnetic Immunity			
The Zeus® Anaesthesia Workstation System is intended for use in the electromagnetic environment specified below. The user of the Zeus® Anaesthesia Workstation System should assure that is used in such an environment.			
Immunity against	**IEC 60601-1-2 test level**	**Compliance level (of Zeus®)**	**Electromagnetic environment**
electrostatic discharge, ESD (IEC 61000-4-2)	contact discharge: ± 6 kV air discharge: ± 8 kV	± 6 kV ± 8 kV	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
electrical fast transients / bursts (IEC 61000-4-4)	power supply lines: ± 2 kV longer input / output lines: ± 1 kV	± 2 kV ± 1 kV	Mains power quality should be that of a typical commercial or hospital environment.
surges on AC mains lines (IEC 61000-4-5)	common mode: ± 2 kV differential mode: ± 1 kV	± 2 kV ± 1 kV	Mains power quality should be that of a typical commercial or hospital environment.
power frequency magnetic field 50/60 Hz (IEC 61000-4-8)	3 A/m	3 A/m	In close vicinity to the Zeus® Anaesthesia Workstation System, no equipment with extraordinary power frequency magnetic fields (power transformers, etc.) should be operated.
voltage dips and short interruptions on AC mains input lines (IEC 61000-4-11)	dip >95%, 0.5 periods dip 60%, 5 periods dip 30%, 25 periods dip >95%, 5 seconds	>95%, 0.5 per. 60%, 5 per. 30%, 25 per. >95%, 5 sec.	Mains power should be that of a typical commercial or hospital environment. If user requires continued operation during power mains interruptions, it is recommended to power the Zeus® Anaesthesia Workstation System from an uninterruptible supply or a battery.
radiated rf (IEC 61000-4-3)	80 MHz – 2.5 GHz: 10 (3) V/m	10 V/m	Recommended separation distance from portable and mobile rf transmitters with transmission power P_{EIRP} to the Zeus® Anaesthesia Workstation System including its lines: 1.84 m * $\sqrt{P_{EIRP}}$ [X1]
rf coupled into lines (IEC 61000-4-6)	150 kHz – 80 MHz: 10 (3) V within ISM bands, 3 V outside ISM bands [X2]	10 V 3 V	Recommended separation distance from portable and mobile rf transmitters with transmission power P_{EIRP} to the Zeus® Anaesthesia Workstation System including its lines: 1.84 m * $\sqrt{P_{EIRP}}$ [X1]

Information re electromagnetic immunity (IEC 60601-1-2: 2001, tables 202, 203, 204)

[X1]: For P_{EIRP} the highest possible "equivalent isotropic radiated power" of the adjacent rf transmitter has to be inserted (value in Watt). Also in the vicinity of equipment marked with the symbol interference may occur. Field strengths from fixed, portable or mobile rf transmitters at the location of the Zeus® Anaesthesia Workstation System should be less than 3 V/m in the frequency range from 150 kHz to 2.5 GHz and less than 1 V/m above 2.5 GHz.

[X2]: ISM bands in this frequency range are: 6.765 MHz - 6.795 MHz, 13.553 MHz - 13.567 MHz, 26.957 MHz - 27.283 MHz, 40.66 MHz - 40.70 MHz.

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Recommended separartion distances

Recommended separation distances between portable and mobile RF-Telecommunication devices and the the Zeus® Anaesthesia Workstation System			
max. P_{EIRP} (W)	**3 V/m distance* (m)**	**1 V/m distance* (m)**	**Hint**
0.001	0.06	0.17	
0.003	0.10	0.30	
0.010	0.18	0.55	
0.030	0.32	0.95	e.g. WLAN 5250 / 5775 (Europe)
0.100	0.58	1.73	e.g. WLAN 2440 (Europe), Bluetooth
0.200	0.82	2.46	e.g. WLAN 5250 (not in Europe)
0.250	0.91	2.75	e.g. DECT devices
1.000	1.83	5.48	e.g. GSM 1800- / GSM 1900- / UMTS- mobiles, WLAN 5600 (not in Europe)
2.000	2.60	7.78	e.g. GSM 900 mobiles
3.000	3.16	9.49	

Information re separation distances (IEC 60601-1-2: 2001, tables 205 and 206)

* 3 V/m distance to transmitters with frequencies from 150 kHz to 2.5 GHz, otherwise 1 V/m distance.

Test list (TL)

Zeus

This test list can be processed with standard commercially available test aids and tools, but does not replace the inspections and maintenance work carried out by the manufacturer Dräger Medical AG & Co. KGaA.

Notes on field of application: Tests marked with the "check" symbol are listed in the test report. The test results are to be documented in the test report.

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1 Unit configuration

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1. 2 Serial numbers (options)
1. 3 Software versions
1. 4 Operating hours

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2. 3 Electrical safety to VDE 0751
2. 4 Electrical safety to IEC 60-601

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3. 7 UPS test
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3.14 Power supply unit
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3.16 Hemodynamics monitoring (if fitted)
3.17 Gas measurement module Zeus (GMZ)
3.18 Ventilation modes
3.19 Unit handover

1 Unit configuration

1.1 Serial numbers

☑ **1.1.1 Zeus** [_____txt]
The serial number is located on the rear panel of the Zeus.

☑ **1.1.2 Breathing-system housing** [_____txt]
The serial number is located on the edge of the housing.

☑ **1.1.3 Compact breathing system cover** [_____txt]
The serial number is located on the edge of the cover.

☑ **1.1.4 Breathing system safety valve** [_____txt]
The serial number is located on the edge of the safety valve.

☑ **1.1.5 Blower** [_____txt]
The serial number is located on the blower pot.

☑ **1.1.6 DIVA metering module, left** [_____txt]
The serial number is located on the rear panel.

☑ **1.1.7 DIVA metering module, right** [_____txt]
The serial number is located on the rear panel.

1.2 Serial numbers (options)

☑ **1.2.1 External bronchial suction device** [_____txt]

☑ **1.2.2 High-pressure regulator O2** [_____txt]

☑ **1.2.3 High-pressure regulator N2O** [_____txt]

☑ **1.2.4 High-pressure regulator AIR** [_____txt]

☑ **1.2.5** **High-pressure cylinder O2** [_____txt]
(if a number is present)

☑ **1.2.6** **High-pressure cylinder N2O** [_____txt]
(if a number is present)

☑ **1.2.7** **High-pressure cylinder AIR** [_____txt]
(if a number is present)

1.3 Software versions

Note: The software versions are read out under step 3.1.

The software versions are read out, enter them in the test report.

☑ **1.3.1** **HERMES** [_____txt]

☑ **1.3.2** **GMZ-PGA** [_____txt]

☑ **1.3.3** **GMZ-SGA** [_____txt]

☑ **1.3.4** **DIVA metering module, left, (DM 168)** [_____txt]
For reading, insert the DIVA module.
Remove the DIVA module afterwards.

☑ **1.3.5** **DIVA metering module, right, (DM 168)** [_____txt]
For reading, insert the DIVA module.
Remove the DIVA module afterwards.

☑ **1.4** **Operating hours** [_____h]
Note: The operating hours are read out under step 3.1.

Read out the operating hours under "Total operat. hours" and enter the value in the test report.

2 Electrical safety

2.1 General

The following section details the tests of electrical safety to VDE 0751 and IEC 601 (or UL 2601-1). Which standard is applicable depends on national regulations (for example, VDE 0751 applies in Germany, whereas the ÖVE-MG 751 law is applicable in Austria).
Some specifications may vary in accordance with the test equipment used.
The Zeus conforms to the requirements of protection class I
With Alveon sensor it conforms to type BF.
With hemodynamic monitoring it conforms to type CF.

2.1.1 Class B

NOTE:
When testing a class B medical device, the device (test specimen) can be irreversibly damaged in the case of an incorrect configuration of the tester with classes BF, CF and mains voltage at the application part. Do not perform the "voltage at application part" test on class B devices.

2.1.2 Operating rooms

NOTE:
When performing tests in room with electrical isolation by means of isolating transformers and isolation monitoring (IT networks in operating rooms), the test instruments must be configured accordingly. Refer to the User Manual of the test instrument.
With "IT network" setting, the internal test in the test instrument "voltage at PE" is suppressed. Non-compliance could lead to incorrect measurements.

2.1.3 Insulated set-up of medical devices

NOTE:
When testing the device or earth leakage currents it must be ensured that the devices are set up such that they are insulated. A part of the leakage currents can discharge, for example, via conductive floors.
Only a differential current measurement may be performed on devices that are not set up such that they are insulated.

2.1.4 Same type of power cables and accessories

NOTE:
Make sure to use the same type of power cables and the same type of accessories when performing repeat measurements. Otherwise, it could result in fluctuating measured values, in particular with low leakage currents. Make sure that the power plug is inserted securely.

2.1.5 Measured value 0.0 microamperes

NOTE:
If a test results in a value of 0.0 microamperes, check whether it is due to a measurement error. Most of the times it is caused by incorrect operation of the test instruments.

☑ 2.2 Visual check [_____OK]

Switch off the Zeus.
Pull the power plug.

Check the following parts for possible damage:
Mains connecting cable including cable-strain relief.
Auxiliary sockets
[OK]

On auxiliary sockets with automatic circuit-breakers, check the circuit-breakers are switched on.
The automatic circuit-breakers are switched on.
[OK]

The ratings of the fuse-links correspond to the imprint.

2.3 Electrical safety to VDE 0751

Precondition:
Zeus is switched off (main switch).

☑ 2.3.1 Protective earth conductor test [_____OK]

Connect the test probe to the following test points one after the other:
Ground stud on the mains input socket.
Ground stud on the auxiliary socket-outlets.
PE contacts on auxiliary socket-outlets.

Enter the higher test value in the test report.

Test value including power cable: R less than/equal to 0.3 ohms.

Using the test probe of the tester measure the resistance to the metal parts of the Zeus listed above.

if available:
Scan the pusher rods of the Dräger Module DPS (syringe pumps) using the test probe.

2.3.2 Device leakage current test

If the values of the leakage current measurement exceed 0.9 times the limit values, the previously measured values shall be used for evaluation. If the comparison shows an abrupt or continuous rise, it should be estimated if the value could exceed the limit value until the next recurrent measurement.
If there is risk of the value being exceeded, check for the possible cause.
Make sure that power supply leads, accessories and system configuration correspond to the previous tests. Insulated installation of the devices is required.
The device is switched on.

☑ 2.3.2.1 Initial value [_____µA]

The initial measured value must not exceed 500 µA.
Each initial value must be transferred to a new test report.

☑ 2.3.2.2 Subsequent measurement [_____µA]

IEA less than/equal to 500 µA, but maximum permissible deviation from initial value is 50%.

2.3.3 Patient leakage current test

If the values of the leakage current measurements exceed 0.9 times the limit values, the previously measured values shall be used for evaluation. If the comparison shows an abrupt or continuous rise, it should be estimated if the value could exceed the limit value until the next recurrent measurement.
If there is risk of the value being exceeded, check for the possible cause.
Make sure that power supply leads, accessories and system configuration correspond to the previous tests. Insulated installation of the devices is required.

If the test is carried out for the first time, enter the initial value in the test report. The subsequent measurements may exceed the initial measured value by max. 50%, but must not exceed the maximum value. In the case of initial measured values < 20 µA, subsequent measurements may deviate by up to 10 µA.

☑ **2.3.3.1** **Initial value, HemoMed POD** [_____µA]

Interconnect the HemoMed POD input pins.

The initial value must be less than/equal to 50 µA.

Each initial value must be transferred to a new test report.

☑ **2.3.3.2** **Subsequent measurement of the HemoMed POD** [_____µA]

The deviation between the subsequent measurement and the initial value must be within permissible tolerance.
[OK]

☑ **2.3.3.3** **Initial value, MultiMed POD** [_____µA]

Interconnect the MultiMed POD input pins.

The initial value must be less than/equal to 50 µA.

Each initial value must be transferred to a new test report.

☑ **2.3.3.4** **Subsequent measurement MultiMed POD** [_____µA]

The deviation between the subsequent measurement and the initial value must be within permissible tolerance.
[OK]

☑ **2.3.3.5** **Initial value, AUX/HEMO2 connection** [_____µA]

Interconnect the AUX/HEMO2 connection pins.

The initial value must be less than/equal to 50 µA.

Each initial value must be transferred to a new test report.

☑ **2.3.3.6** **AUX/HEMO2 connection** [_____µA]

The deviation between the subsequent measurement and the initial value must be within permissible tolerance.
[OK]

☑ **2.3.3.7** **Initial value, AUX/HEMO3 connection** [_____µA]

Interconnect the AUX/HEMO3 connection pins.

The initial value must be less than/equal to 50 µA.

Each initial value must be transferred to a new test report.

☑ **2.3.3.8** **Subsequent measurement of the AUX/HEMO3 connection** [_____µA]

The deviation between the subsequent measurement and the initial value must be within permissible tolerance.
[OK]

2.4 Electrical safety to IEC 60-601

Precondition:
Zeus is switched off.

IEC 601/1 is an international standard for type testing of medical devices. It is not intended for repeat measurements. Most countries do not have repeat measurements for medical devices as is the case in Germany (VDE 0751). Therefore section 18 (protective earth conductor test) and section 19 (leakage current test) of the IEC 601/1 are used.

Since the complete electrical safety tests according to IEC 601/1 is very extensive and not feasible in the field, this test instruction is applicable:
Protective earth conductor test,
Leakage current tests in normal mode and with interrupted PEN conductor.

This corresponds to tests according to VDE 0751.
The leakage current test with interrupted PE and the housing leakage current test are not applicable.

Reason:
Dräger devices have been type-tested according to IEC 601/1 and comply with the complete safety requirements. Recurrent measurements are intended to shows any changes.
The protective earth conductor test makes sure that the PE is not interrupted.

Changes in the housing leakage current are only to be expected after design changes. However, design changes in the field, if any, are only carried out according to appropriate conversion instructions.

2.4.1 Protective earth conductor test

Connect the test probe to the following test points one after the other:
Ground stud on the mains input socket.
Ground studs on auxiliary socket-outlets.
PE contacts on auxiliary socket-outlets.

Enter the higher test value in the test report.

The test to UL2601-1 is satisfied by testing to IEC 60-601-1. Differing limit values are marked.
Note regarding wall-mounted and ceiling-mounted devices with permanently wired power cable:

The protective conductor measurement should be taken between grounded metal parts of the ceiling pendant/wall mounting and the Zeus.
Connect the test cable for protective conductor contact resistance 7900882 to the tester. The black conductor of this test cable is wired to the earthing contacts of the three-pin plug.
Connect the black conductor of the test cable to the metal parts of the ceiling pendant/wall mounting. Using the test probe of the tester measure the resistance to the metal parts of the Zeus listed above.

☑ 2.4.1.1 PE conductor test value [_____OK]

Test value including power cable: R less than/equal to 0.3 ohms

2.4.2 Earth leakage current

NOTE:
The earth leakage current test must be carried out with reversed and non-reversed power plug. Enter the highest value.

NOTE:
Make sure that power supply leads, accessories and system configuration correspond to the previous tests. Insulated installation of the devices is required.

☑ **2.4.2.1 Earth leakage current N.C. (IEC)** [_____µA]

(normal condition)
Test value to IEC 60-601: less than/equal to 500 µA

☑ **2.4.2.2 Earth leakage current N.C. (UL)** [_____µA]

(normal condition)
Test value to UL 2601-1: less than/equal to 300 µA

☑ **2.4.2.3 Earth leakage current S.F.C. (IEC)** [_____µA]

(single fault condition, PEN conductor interrupted)
Test value to IEC 60-601: less than/equal to 1000 µA

☑ **2.4.2.4 Earth leakage current S.F.C. (UL)** [_____µA]

(single fault condition, PEN conductor interrupted)
Test value to UL 2601-1: less than/equal to 300 µA

☑ **2.4.2.5 Earth leakage current N.C. reversed (IEC)** [_____µA]

(normal condition, power plug reversed)
Test value to IEC 60-601: less than/equal to 500 µA

☑ **2.4.2.6 Earth leakage current N.C. reversed (UL)** [_____µA]

(normal condition, power plug reversed)
Test value to UL 2601-1: less than/equal to 300 µA

☑ **2.4.2.7 Earth leakage current S.F.C. reversed (IEC)** [_____µA]

(single fault condition, PEN conductor interrupted, power plug reversed)
Test value to IEC 60-601: less than/equal to 1000 µA

☑ **2.4.2.8 Earth leakage current S.F.C. reversed (UL)** [_____µA]

(single fault condition, PEN conductor interrupted, power plug reversed)
Test value to UL 2601-1: less than/equal to 300 µA

2.4.3 Patient leakage current test

NOTE:
The patient leakage current test must be carried out with reversed and non-reversed power plug. Enter the highest value. This test can be implemented internally on most of the testers.

NOTE:
Make sure that power supply leads, accessories and system configuration correspond to the

previous tests. Insulated installation of the devices is required.

2.4.4 HemoMed POD

Interconnect the HemoMed POD input pins.

☑ **2.4.4.1 Patient leakage current N.C.** [_____µA]

(normal condition)
Test value: less than/equal to 100 µA

☑ **2.4.4.2 Patient leakage current S.F.C.** [_____µA]

(single fault condition, PEN conductor interrupted)
Test value: less than/equal to 500 µA

☑ **2.4.4.3 Patient leakage current N.C. reversed** [_____µA]

(normal condition, power plug reversed)
Test value: less than/equal to 100 µA

☑ **2.4.4.4 Patient leakage current S.F.C. reversed** [_____µA]

(single fault condition, PEN conductor interrupted, power plug reversed)
Test value: less than/equal to 500 µA

2.4.5 MultiMed POD

Interconnect the HemoMed POD input pins.

☑ **2.4.5.1 Patient leakage current N.C.** [_____µA]

(normal condition)
Test value: less than/equal to 100 µA

☑ **2.4.5.2 Patient leakage current S.F.C.** [_____µA]

(single fault condition, PEN conductor interrupted)
Test value: less than/equal to 500 µA

☑ **2.4.5.3 Patient leakage current N.C. reversed** [_____µA]

(normal condition, power plug reversed)
Test value: less than/equal to 100 µA

☑ **2.4.5.4 Patient leakage current S.F.C. reversed** [_____µA]

(single fault condition, PEN conductor interrupted, power plug reversed)
Test value: less than/equal to 500 µA

2.4.6 AUX/HEMO2 connection

Interconnect the AUX/HEMO2 connection pins.

☑ **2.4.6.1** **Patient leakage current N.C.** [_____µA]

(normal condition)
Test value: less than/equal to 100 µA

☑ **2.4.6.2** **Patient leakage current S.F.C.** [_____µA]

(single fault condition, PEN conductor interrupted)
Test value: less than/equal to 500 µA

☑ **2.4.6.3** **Patient leakage current N.C. reversed** [_____µA]

(normal condition, power plug reversed)
Test value: less than/equal to 100 µA

☑ **2.4.6.4** **Patient leakage current S.F.C. reversed** [_____µA]

(single fault condition, PEN conductor interrupted, power plug reversed)
Test value: less than/equal to 500 µA

2.4.7 **AUX/HEMO3 connection**

Interconnect the AUX/HEMO3 connection pins.

☑ **2.4.7.1** **Patient leakage current N.C.** [_____µA]

(normal condition)
Test value: less than/equal to 100 µA

☑ **2.4.7.2** **Patient leakage current S.F.C.** [_____µA]

(single fault condition, PEN conductor interrupted)
Test value: less than/equal to 500 µA

☑ **2.4.7.3** **Patient leakage current N.C. reversed** [_____µA]

(normal condition, power plug reversed)
Test value: less than/equal to 100 µA

☑ **2.4.7.4** **Patient leakage current S.F.C. reversed** [_____µA]

(single fault condition, PEN conductor interrupted, power plug reversed)
Test value: less than/equal to 500 µA

3 **Function and condition test**

Note:
The DIVA must not be operated with O2 at the Air inlet.

☑ **3.1** **Input test** [_____OK]

Precondition:
DIVA metering module is not plugged in.
Zeus is switched off.

To detect possible device faults at an early stage, this step tests whether the self-test was completed without error.
Upgrade and install complete compact breathing system.

Connect pipeline supply.
Connect mains power supply.
Switch on Zeus.
All LEDs of the pipeline supply and of the cylinder supply are activated at the same time in red and green, that is why they show an orange light for a short period.
[OK]

Read the check list.
Power-on test is run through without error.
[OK]

Zeus is in ventilator standby mode.
[OK]

Open the service window, password "8090".

Select the service window tab "System Info".
Read the software versions and enter them in the report under test item 1.3.

Select the service window tab "System Data".
Read out the operating hours under "Total Operat. Hours" and enter the value in the test report under item 1.4.

Select the service window tab "Info Log".
The Info Log does not contain any conspicuous error codes from the last 7 days.
[OK]

Switch off the Zeus.

☑ 3.2 Accompanying documents [_____OK]

Instructions for Use and unit log available according to operators

3.3 Anesthetic gas scavenging (AGS) system

☑ 3.3.1 Condition of AGS [_____OK]

Replace particle filter (M 33294) if necessary. If one of the two excess gas connections is used: Screw plug fitted in socket on side of AGS mounting system.

☑ 3.3.2 Function of AGS [_____OK]

Connect AGS suction hose to terminal unit of the anesthetic gas scavenging line.
The float in the flowmeter tube of the AGS system should move between the upper and lower marks.

☑ 3.3.3 Function of flow control in AGS USA variant [_____OK]

Adjust flow-control valve at outlet of AGS system.
Position of float in flowmeter tube of AGS system changes.
Adjust the flow control valve such that the float is in the middle position.

3.4 Bronchial suction device (if fitted)

☑ 3.4.1 Condition of bronchial suction device [_____OK]

Housing.
Vacuum switch.
Control valve.
Pressure gauge.
Connecting hose from suction device to secretion container.
Vacuum connecting hose (only with vacuum suction device).
Compressed-gas hose (only with ejector suction device).

☑ 3.4.2 Condition of secretion tank and accessories [_____OK]

Secretion suction hose.
Secretion container.
Cylinder caps.
Float
Pressure relief valve (if fitted).
mica insulator

Check the ejector suction or vacuum suction, depending on which is fitted.

3.4.3 Ejector extraction

In case of vacuum suction device continue with test "Vacuum suction device".

Set up and connect up complete suction system.
Connect AIR supply (2.7 bar to 6.9 bar).
Set the vacuum switch to "Control" mode.
Set flow control valve to maximum pressure and seal off secretion suction tube.
Read off the negative pressure from the pressure gauge on the bronchial suction device.

☑ 3.4.3.1 Performance test [_____OK]

P = -0.5 bar in 10 s

☑ 3.4.3.2 Static final pressure [_____OK]

Pstat = -0.5 bar to -0.95 bar

☑ 3.4.3.3 Function of non-return valve [_____OK]

Connect a pressure gauge to the vacuum connection (+- 1 bar measuring range)
Set vacuum switch to "Full Capacity" position unit P-vacuum is constant.
Pstat = -0.5 bar to -0.95 bar
[OK]

Set the vacuum switch to "OFF" position.
Pressure drop within 1 minute < 50 mbar.

☑ **3.4.3.4 Function of vacuum switch** [_____OK]

Set the vacuum switch to "Control" mode.
Seal off secretion suction tube.
Set the vacuum switch to "Full Capacity" position.
Vacuum switch can be switched to "Full Capacity" position.
[OK]

Set the vacuum switch to "OFF" position.
Disconnect the pipeline supply.
Continue with test step "Function of auxiliary O2 flowmeter next to test cone (if fitted)".

3.4.4 Vacuum extraction

☑ **3.4.4.1 Function of vacuum extraction** [_____OK]

Set up and connect up complete vacuum system.
Connect vacuum tube.
Set the vacuum switch to "Control" mode.
Set flow control valve to maximum pressure and seal off secretion suction tube.
The vacuum Pvac is built up.

☑ **3.4.4.2 Function of vacuum switch** [_____OK]

Set the vacuum switch to "Control" mode.
Seal off secretion suction tube.
With a flow control valve, set a negative pressure of approx. 1/2 Pvac.
Set the vacuum switch to "Full Capacity" position.
P = Pvac
[OK]

Set the vacuum switch to "OFF" position.
Disconnect vacuum tube.

☑ **3.5 Function of auxiliary O2 flow meter next to test cone (if fitted)** [_____OK]

Precondition:
DIVA metering module is not plugged in.
O2 pipeline supply is connected (the others are not).

A flowmeter block is connected to the outlet of the auxiliary O2 flowmeter tube.

Set the auxiliary O2 flowmeter tube to 9 L/min.
Read off flow from flowmeter block.
The flow is between 8.1 L/min and 9.9 L/min.
[OK]

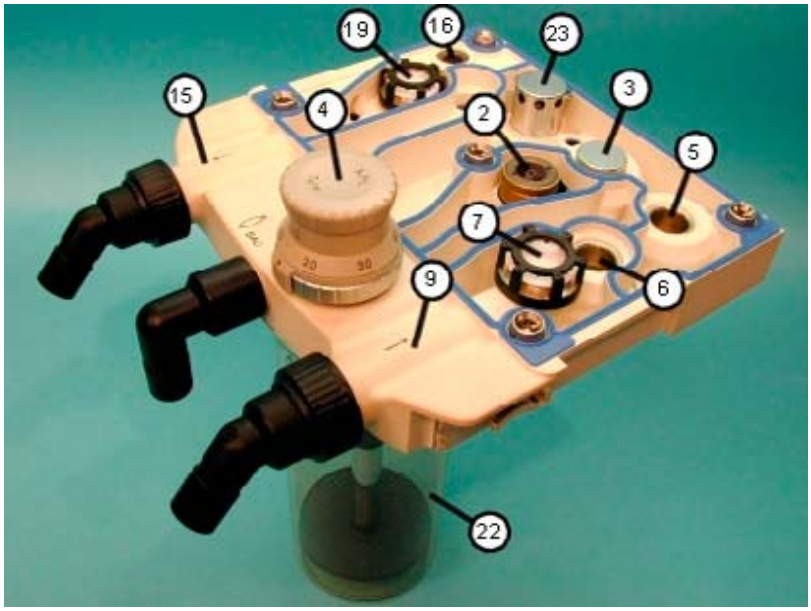
Remove the test set-up.

3.6 Breathing system

Precondition:
DIVA metering module is not plugged in.
The compact breathing system has been removed.

☑ 3.6.1 Condition of breathing system housing [_____OK]

Condition of respiratory gas block. No cracks or other damage.
Condition of inspiratory non-return valve (3.19) and expiratory non-return valve (3.7). Look especially for dirt contamination and damage to the seat and the ceramic disk.
Condition of inspiratory and expiratory socket. Additionally unscrew sockets, remove flow sensors and check 4 * O-ring for flow sensor sealing.
Condition of APL valve seat.
Condition of AGS non-return valve (3.2).
Condition of Closed valve diaphragm (3.3).
Condition of Spont valve diaphragm (3.5).
Condition of breathing system sealing MK01265.
Condition of flow valve diaphragm (3.6).
Condition of breathing system safety valve (3.16).
Condition of auxiliary Air valve (3.23).
Condition of Closed valve seat (3.3).
Condition of Spont valve seat (3.5).
Condition of flow valve seat (3.6).
Condition of absorber canister seal M33723.
Condition of absorber element seal 8602960.
Condition/function of manual breathing bag socket.



☑ 3.6.2 Mechanical safety valve (3.16) [_____hPa]

Measurement set-up:
Connect a reducer and a tube with T-piece to the inspiratory port of the breathing system.
Connect a hand pump to one end of the T-piece.
Connect a digital manometer to the other end of the T-piece.

Measurement:
Build up pressure with the hand pump until the mechanical safety valve (3.16) opens.
Read value of the digital manometer.
The opening pressure must be between 75 hPa and 0.95 hPa.

The test set-up is also used for the pressure gauge test.

☑ 3.6.3 Pressure gauge (3.32) [_____hPa]

Precondition:
DIVA metering module is not plugged in.

The test set-up is the same as used in the mechanical safety valve test.
Using the hand pump, generate a pressure of 70 hPa (read off on the digital manometer).
The pressure indicated on the pressure gauge (3.32) must be between 60 hPa and 80 hPa.
Remove the test set-up.

☑ 3.7 UPS test [_____OK]

Precondition:
DIVA metering module is not plugged in.
This test includes a check of the battery capacity. Consequently, the battery must be fully charged.
Zeus is connected to the mains power supply.

The external power LED lights up. The LED is on the front panel of the Zeus.
[OK]

Check the capacity of the rechargeable battery in the “service dialog” window. The battery charge must be 90% to 100%.
[OK]

Disconnect the Zeus power plug from the mains power supply and start the stopwatch.
Note: In the battery capacity test, the Zeus must be operated for 30 minutes without mains power. During this time you can continue with the other tests. After 30 minutes the mains power must be restored.

The external power indicator LED goes out and the battery power indicator LED lights up.
[OK]

Zeus is powered by the UPS for 30 minutes.
[OK]

At the end of the 30 minutes reconnect the mains power plug to the mains power supply.

3.8 High-pressure modification set (if fitted)

☑ 3.8.1 Condition of high-pressure conversion kit [_____OK]

☑ 3.8.2 High-pressure regulator performance test [_____OK]

Info:
The respective version (2.5 bar or 5 bar) is indicated on the name plate of the high-pressure regulator.

Close the high-pressure cylinder.
Disconnect the connecting tube of the high-pressure regulator being tested from the Zeus and connect it to a flowmeter (measuring range > 75 L/min).
Switch on Zeus.
Confirm the checklist.

The cylinder pressures (supply pressure) are shown on the self-test screen.
Open the relevant high-pressure cylinder slowly until a flow of 80 L/min is reached.
The supply pressure is less than 10 bar. Close the high-pressure cylinder.
Connect the connecting hose of the high-pressure regulator to the Zeus.

☑ 3.8.3 Downstream pressure test [_____OK]

Close the high-pressure cylinders.
Disconnect the connecting tube of the high-pressure regulator being tested from the Zeus and connect it to a pressure gauge (measuring range 10 bar).
Open the high-pressure cylinder.
Read the downstream pressure on the pressure gauge.

Variant 2.5 bar -> downstream pressure 2.4 to 2.95 bar.
Variant 5 bar -> downstream pressure 5 to 6 bar.

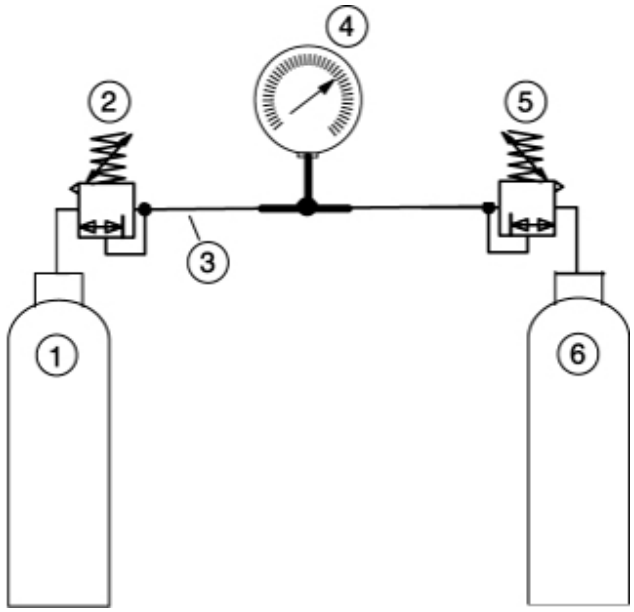
3.8.4 Blow-off valve test

Info:
This test requires the use of a controllable high-pressure regulator (control range up to 10 bar) with an high-pressure cylinder.

Prepare the following test set-up.

Legend to figure:
1 = High-pressure cylinder on Zeus
2 = High-pressure regulator on Zeus
3 = Connecting hose to Zeus
4 = Pressure gauge, measuring range 10 bar
5 = Controllable test pressure regulator
6 = Test cylinder

Leave the high-pressure cylinder on Zeus (1) closed.
Adjust the least possible pressure on the test pressure regulator.
Open the test cylinder (6).
Use the test pressure regulator to increase the pressure until the blow-off valve opens and a flow noise can be heard. Repeat this procedure twice and then read the opening pressure off the pressure gauge (4) of the test pressure regulator (and record the value).



☑ **3.8.4.1** **O2 opening pressure (if available)** [_____bar]

Tolerance: 6.5 bar to 8.5 bar.

☑ **3.8.4.2** **N2O opening pressure (if available)** [_____bar]

Tolerance: 6.5 bar to 8.5 bar.

☑ **3.8.4.3** **AIR opening pressure (if available)** [_____bar]

Tolerance: 6.5 bar to 8.5 bar.

☑ **3.8.5** **High-pressure sensors reference pressure test** [_____OK]

Info:
The internal pressure of the high-pressure cylinders must be known for this test.

Connect the high-pressure connecting hose to Zeus.
Switch on Zeus and wait until the check list is displayed.
Open the high-pressure cylinders. Compare the pressure displayed in the check list with the internal pressure of the high-pressure cylinders.
The O2 pressure reading corresponds to the internal pressure of the O2 high-pressure cylinder (maximum deviation 10%). The O2 high-pressure LED on the Zeus front lights green.
[OK]

The AIR pressure reading (if available) corresponds to the internal pressure of the AIR high-pressure cylinder (maximum deviation 10%). The AIR high-pressure LED on the Zeus front lights green.
[OK]

The N2O pressure reading (if available) corresponds to the internal pressure of the N2O high-pressure cylinder (maximum deviation 10%). The N2O high-pressure LED on the Zeus front lights green.
[OK]

Close the high-pressure cylinders.
Switch Zeus off.

☑ 3.9 External O2 flowmeter (if fitted) [_____OK]

Connect the Zeus to the O2 pipeline supply (the other pipeline supply must not be connected).
Open the fine control valve of the external O2 flowmeter.
The float of the external O2 flowmeter ascends.
[OK]

Close the fine control valve of the external O2 flowmeter.

☑ 3.10 Function of safety flow adjuster [_____OK]

Check the safety O2.
Manually seal off the filter on the Alveon flow sensor or connect the test lung.
Press the “safety O2” control knob to raise it and then turn it to set an O2 flow.
The breathing bag inflates.
Turn the “safety O2” back to its original position and push it in.

3.11 Function of O2 flush

☑ 3.11.1 Mechanical functioning of O2 flush [_____OK]

Operate the left-hand O2 flush and then release it again.
The left-hand O2 flush button does not stick. Breathing bag inflates, flow-in noise is audible.
[OK]

Operate the right-hand O2 flush and then release it again.
The right-hand O2 flush button does not stick. Breathing bag inflates, flow-in noise is audible.
[OK]

☑ 3.12 Blower [_____OK]

Remove the blower and check the blower spindle replacement date indicated on the blower pot. If the replacement date of the blower spindle is older than 2 years, replace the blower spindle.
[OK]

Wipe-disinfect the blower cover MK01244 (only necessary when replacing the blower spindle).
Follow the hospital's hygiene regulations.

Seal off the outlet of the blower.
Connect a tube to the inlet. Connect a T-piece to the free end of the tube. Connect a syringe and the digital manometer to the T-piece. Using the syringe, feed 5 mL into the blower.
5 mL generate a pressure of approx. 60 mbar. Do not generate a higher pressure; otherwise the seal (max. 130 mbar) will be damaged.
The permissible pressure drop is <= 8 mbar/minute.
[OK]

Refit the blower.
Insert the breathing system.

☑ 3.13 DIVA metering module [_____OK]

Check the condition of the DIVA metering module(s).

☑ 3.14 Power supply unit [_____OK]

[Check condition]

☑ 3.14.1 Power failure alarm [_____OK]

Select any ventilation mode on the Zeus.
Pull the power plug.
A visual and an audible alarm are triggered.

☑ 3.15 Zeus power-on test [_____OK]

Precondition:
DIVA metering module is not plugged in.
Mains power is connected.
Zeus is switched off.

Upgrade and install complete compact breathing system.
Connect pipeline supply.
Connect mains power supply.
Connect the metering modules.
Switch on Zeus.
On power-up and after approx. 10 seconds a short tone sounds.
[OK]

When the checklist appears, read it.
The power-on test is run through without error.
[OK]

The leakage values for "auto" and "MAN/Spont" are < 100 mL/min.
[OK]

Zeus switches to standby mode.
[OK]

Membrane keypad:
Switch to running mode.

Press each key on the HERMES membrane keypad and check the feedback on the display.
All keys are working.
[OK]

Backlighting:
Select the brightness/sound volume adjustment function on the membrane keypad.
Check the brightness control function by altering the setting.
[OK]

Reset brightness to original setting.

Alarm generator:
Select the brightness/sound volume adjustment function on the membrane keypad.
Check the sound volume control function by altering the setting.
[OK]

Reset volume to original setting.

Lamp:

Select the brightness/sound volume adjustment function on the membrane keypad.
Check the brightness of the lamp by altering the setting.
[OK]

Reset brightness to original setting.

3.16 Hemodynamics monitoring (if fitted)

Precondition:
DIVA metering module is not plugged in.
Mains power is connected.
HemoMed POD and MultiMed POD are connected to Zeus.
Zeus is switched on.
The checklist has been read.
The software option for hemodynamics monitoring in Zeus is activated.
The power-on test was completed without errors.
The display menu for hemodynamics parameters on the Zeus display is open.

3.16.1 ECG

Set the ECG simulator "phantom" to a frequency of 75.

☑ 3.16.1.1 ECG display [_____OK]

HR is 70 to 90 bmp.
[OK]

The heart symbol flashes on the Zeus screen and the pulse tone is generated for each QRS complex.
[OK]

Peaks are displayed for each QRS complex.
[OK]

☑ 3.16.1.2 Interruption of an ECG electrode [_____OK]

Interrupt each ECG electrode connection one after the other using the ECG simulator.

With RA electrodes, the messages "Lead error" and "RA electrode disconnected" appear.
The pulse tone stops and "---" appears on the heart rate display.

With LA electrodes, the messages "Lead error" and "LA electrode disconnected" appear.
The pulse tone stops and "---" appears on the heart rate display.

With LL electrodes, the messages "Lead error" and "LL electrode disconnected" appear.
The pulse tone remains. The heart rate display remains.

With RL electrodes, the messages "Lead error" and "RL electrode disconnected" appear.
The pulse tone remains. The heart rate display remains.

With V electrodes, the message "V electrode disconnected" appears.
The pulse tone remains. The heart rate display remains.

With V+ electrodes, the message "V+ electrode disconnected" appears.
The pulse tone remains. The heart rate display remains.

Connect all ECG electrodes to the ECG simulator.

☑ 3.16.1.3 Alarm function [_____OK]

Set the following alarm limits on the Zeus display:
HR upper limit: 110 bpm
HR lower limit: 40 bpm
Alarm: ON

The following alarms must be displayed:
HR = 120 to 0.140 bpm
The HR values flashes and the color changes.
The alarm signal sounds.
The "Heart rate/pulse high" alarm is displayed in the message window.
[OK]

Adjust the alarm limits such that the alarm messages are canceled.
The HR value stops flashing and the color changes to normal.
HR = 70 to 90.
The message window continues displaying the last alarm "HR > 110".
[OK]

Press the alarm silence key.
The display of the last alarm is cleared.
[OK]

☑ 3.16.1.4 Asystole [_____OK]

Switch off the ECG simulator.
The following alarms must be displayed:
The HR field shows the message "Asystole".
The message window shows the alarm "Asystole".
The alarm signal sounds.
[OK]

Switch on the ECG simulator.

☑ 3.16.2 SPO2 [_____OK]

Condition test of the SPO" cable and sensor.
[OK]

Connect SPO2 cable with finger clip to your own finger.
SPO2 display > 90
[OK]

Your own pulse rate is indicated.
[OK]

☑ 3.16.3 Temperature [_____OK]

The sensor bears a valid calibration label.
Plug the sensor into the parameter box and measure the room temperature.
Perform a reference measurement using an external temperature measuring device.

Test value: After approx. 2 minutes, the measured value should correspond to the room temperature (tolerance +/-0.5 °C).

Temperature sensor input T1.
Temperature sensor input T2.

☑ 3.16.3.1 NIBP measurement check [_____OK]

Connect cuff to Zeus.
Vent cuff and attach firmly to the upper arm so that the tube rests in the crook of the arm and the rubber chamber rests directly on the arm.
Operate the Start/Stop key in the NIBP menu.
Minimize your movement and wait until the measurement is complete.
Your current blood pressure values are displayed.
[OK]

If necessary, repeat the measurement making sure the cuff is positioned properly.

3.16.4 IBP

connect the HemoMed POD to the Zeus.

☑ 3.16.4.1 Zero calibration of the sensors [_____OK]

Vent all existing IBP sensors.
Select "Zero all IBP" on Zeus.

NOTE: Zero calibration of all four pressures takes place simultaneously, even if only channels A and B of the HemoMed POD are used.
No error message appears when the zero calibration has been completed successfully.

☑ 3.16.4.2 Function test of the IBP pressure sensors [_____OK]

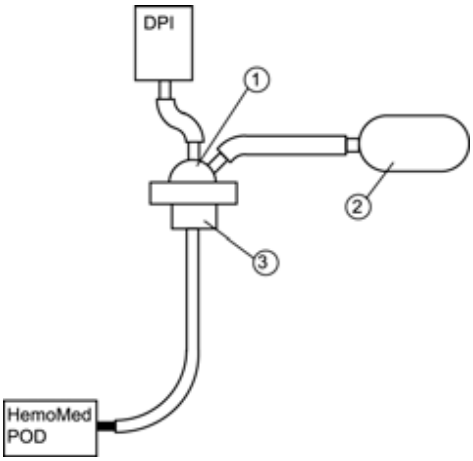
Figure: IBP pressure sensor test set-up
Prepare the test set-up as shown in the figure with the first IBP sensor input.
Check that the connectors are connected securely.
[OK]

Perform a visual check on cable and sensor.
[OK]

Use the manual bellows to build up a pressure until the DPI indicates exactly 100 mbar.
The following is shown in the IBP display field:
73 ... 79 mm Hg
9,6 ... 10.4 kPa
[OK]

Depressurize and repeat the test with each IBP sensor input.
Remove the test set-up.

Legend to figure:
1 = pressure dome
2 = manual bellows
3 = pressure sensor



3.17 Gas measurement module Zeus (GMZ)

Note: The tests on the SGA without water trap shall be performed rapidly in order to avoid contaminations during operation without water trap and filter!

Precondition:
DIVA metering module is not plugged in.
Gas supply is connected.
Zeus has been switched on for 15 minutes and is in "Running Mode":
(Man/Spont, auto metering, 100% O2, 2 L/min, no anesthetic gas, Y-piece connected).

☑ 3.17.1 O2 measurement of the PGA (ServoMex) [_____OK]

Precondition:
DIVA metering module is not plugged in.
Zeus is switched on and in "Running Mode".
The service window with the "System Data" tab is open.

Expose sampling line to 100% O2 (e.g. O2 cylinder).
Read off the value GMZ-PGA "O2".
The measured value is 97% O2 ... 0.103% O2.
[OK]

Hold the sampling line open to the ambient air.
Read off the value GMZ-PGA "O2".
The measured value is 19.9% O2 ... 22.9% O2.
[OK]

☑ 3.17.2 O2 measurement of the SGA (Oxytrace) [_____%O2]

Precondition:
DIVA metering module is not plugged in.
Zeus is switched on and in "Running Mode".
The service window with the "System Data" tab is open.

Operate the O2 flush for about 10 seconds.
The displayed O2 values should be in the range 97% O2 .... 0.103% O2.

☑ 3.17.3 CO2 measurement of the PGA (ServoMex) [_____OK]

Precondition:
DIVA metering module is not plugged in.
Zeus is switched on and in "Running Mode".
Disconnect the sampling tube from the Alveon sensor.
Breathe into the sampling tube.
CO2 value is displayed.

☑ 3.17.4 Gas measurement function test [_____OK]

Insert the DIVA metering module containing any type of anesthetic agent into the supply module.
Connect the anesthetic gas filter to the AGS.
Using the Hermes touch-screen make the following adjustments:

Switch the device to fresh-gas mode "Auto Metering" so that the inspiratory limb is the SGA measuring location.
Set the fresh-gas supply to 30% O2 and 70% Air.
Set the anesthetic gas concentration as follows:
H, E, I = 1 vol.%
S = 2 vol.%
DE = 5 vol.%

The specified anesthetic gas is detected by the PGA.
[OK]

The anesthetic gas value measured by the PGA must be stable and within the specified range.
[OK]

H, E, I = 0.6 ... 1.4 vol.%
S = 1.4 ... 2.6 vol.%
DE = 3.8 ... 6.2 vol.%

The CO2 value measured by the PGA must be stable and less than/equal to 0.2 vol.%.
[OK]

The anesthetic gas value measured by the SGA must be stable and within the specified range.
[OK]

H, E, I = 0.6 ... 1.4 vol.%
S = 1.4 ... 2.6 vol.%
DE = 3.8 ... 6.2 vol.%

The CO2 value measured by the SGA must be stable and less than/equal to 0.5 vol.%.
[OK]

Switch off the ventilation function.

Remove the dosage modules.

3.18 Ventilation modes

Precondition:
Compact breathing system is completely upgraded and installed.
The pipeline supply is connected.
Mains power is connected.
Zeus is switched on.

The checklist has been read.
The power-on test was completed without errors.
Zeus is in standby mode.

☑ 3.18.1 Manual ventilation [_____OK]

Connect the test lung.
Set Zeus to Man/Spont mode.
Set the fresh-gas flow to 2 L/min.
Press and hold down Flush button until manual breathing bag is filled.
The manual breathing bag can be used to provide manual ventilation.
[OK]

☑ 3.18.2 Spontaneous breathing [_____OK]

Set the APL valve to "Spont" position.
The test lung can be used to provide spontaneous breathing.
[OK]

Set the APL valve to "Man" position.

☑ 3.18.3 Pressure Mode [_____OK]

Carry out this test with high-pressure cylinders.
Disconnect the pipeline supply. Open the cylinders.

Switch Zeus to "Pressure Mode" mode.
Select the following parameters:
Freq: 12/min
Tinsp: 1.7 s; if not possible, adjust via TI:TE.
Ramp: 0.2 s
PEEP: 3 hPa
Pinsp: 20 mbar

Press the "Home" key to select the data screen.
Check the following measured values:
PLAT = 17 hPa to 23 hPa
[OK]

PEEP = -2 hPa to +4 hPa
[OK]

Close cylinders.
Connect pipeline supply.

☑ 3.18.4 Volume Mode (const. Flow) [_____OK]

Switch Zeus to "Volume Mode mode (const. Flow)“.
Select the following parameters:
PMAX: 50 hPa
VT: 800 mL
Freq: 12/min
Ti : Te = 1 : 2
TPAUSE:TINSP: 20 %
PEEP: 10 hPa

Press the "Adjust alarm limits" key.

After about 10 breaths check the following measured values:
PEEP = 8 hPa to 12 hPa
[OK]

VT = 0.74 L/min to 0.86 L/min
[OK]

Switch Zeus to standby.

3.18.5 Control loops test

☑ **3.18.5.1 Insp. O2** [_____OK]

Insp. O2 = 25%,
Carrier gas = Air,
Start ventilation,
Mode = let uptake stabilize,
virtual flowmeters indicate 0 L/min
[OK]

then O2 = 50% ==> flow increases to O2 = 50%
[OK]

then flow returns to 0 L/min
[OK]

☑ **3.19 Unit handover** [_____OK]

Place fully functional unit at the user's/owner's disposal.

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Test Report TL

Institution _____ **Product name** _____

Contact _____ **Reference number** _____

OK	Para	Name	Result
1		**Unit configuration**	
1. 1		**Serial numbers**	
☐	1. 1. 1	Zeus	
☐	1. 1. 2	Breathing-system housing	
☐	1. 1. 3	Compact breathing system cover	
☐	1. 1. 4	Breathing system safety valve	
☐	1. 1. 5	Blower	
☐	1. 1. 6	DIVA metering module, left	
☐	1. 1. 7	DIVA metering module, right	
1. 2		**Serial numbers (options)**	
☐	1. 2. 1	External bronchial suction device	
☐	1. 2. 2	High-pressure regulator O2	
☐	1. 2. 3	High-pressure regulator N2O	
☐	1. 2. 4	High-pressure regulator AIR	
☐	1. 2. 5	High-pressure cylinder O2	
☐	1. 2. 6	High-pressure cylinder N2O	
☐	1. 2. 7	High-pressure cylinder AIR	
1. 3		**Software versions**	
☐	1. 3. 1	HERMES	
☐	1. 3. 2	GMZ-PGA	
☐	1. 3. 3	GMZ-SGA	
☐	1. 3. 4	DIVA metering module, left, (DM 168)	
☐	1. 3. 5	DIVA metering module, right, (DM 168)	
☐	1. 4	Operating hours	h
2		**Electrical safety**	
☐	2. 2	Visual check	
2. 3		**Electrical safety to VDE 0751**	
☐	2. 3. 1	Protective earth conductor test	
2. 3. 2		**Device leakage current test**	
☐	2. 3. 2. 1	Initial value	µA
☐	2. 3. 2. 2	Subsequent measurement	µA
2. 3. 3		**Patient leakage current test**	
☐	2. 3. 3. 1	Initial value, HemoMed POD	µA
☐	2. 3. 3. 2	Subsequent measurement of the HemoMed POD	µA
☐	2. 3. 3. 3	Initial value, MultiMed POD	µA
☐	2. 3. 3. 4	Subsequent measurement MultiMed POD	µA
☐	2. 3. 3. 5	Initial value, AUX/HEMO2 connection	µA
☐	2. 3. 3. 6	AUX/HEMO2 connection	µA
☐	2. 3. 3. 7	Initial value, AUX/HEMO3 connection	µA
☐	2. 3. 3. 8	Subsequent measurement of the AUX/HEMO3 c	µA
2. 4		**Electrical safety to IEC 60-601**	
2. 4. 1		**Protective earth conductor test**	
☐	2. 4. 1. 1	PE conductor test value	
2. 4. 2		**Earth leakage current**	
☐	2. 4. 2. 1	Earth leakage current N.C. (IEC)	µA
☐	2. 4. 2. 2	Earth leakage current N.C. (UL)	µA
☐	2. 4. 2. 3	Earth leakage current S.F.C. (IEC)	µA

OK	Para	Name	Result
☐	2. 4. 2. 4	Earth leakage current S.F.C. (UL)	µA
☐	2. 4. 2. 5	Earth leakage current N.C. reversed (IEC)	µA
☐	2. 4. 2. 6	Earth leakage current N.C. reversed (UL)	µA
☐	2. 4. 2. 7	Earth leakage current S.F.C. reversed (IEC)	µA
☐	2. 4. 2. 8	Earth leakage current S.F.C. reversed (UL)	µA
2. 4. 3		**Patient leakage current test**	
☐	2. 4. 4. 1	Patient leakage current N.C.	µA
☐	2. 4. 4. 2	Patient leakage current S.F.C.	µA
☐	2. 4. 4. 3	Patient leakage current N.C. reversed	µA
☐	2. 4. 4. 4	Patient leakage current S.F.C. reversed	µA
☐	2. 4. 5. 1	Patient leakage current N.C.	µA
☐	2. 4. 5. 2	Patient leakage current S.F.C.	µA
☐	2. 4. 5. 3	Patient leakage current N.C. reversed	µA
☐	2. 4. 5. 4	Patient leakage current S.F.C. reversed	µA
☐	2. 4. 6. 1	Patient leakage current N.C.	µA
☐	2. 4. 6. 2	Patient leakage current S.F.C.	µA
☐	2. 4. 6. 3	Patient leakage current N.C. reversed	µA
☐	2. 4. 6. 4	Patient leakage current S.F.C. reversed	µA
☐	2. 4. 7. 1	Patient leakage current N.C.	µA
☐	2. 4. 7. 2	Patient leakage current S.F.C.	µA
☐	2. 4. 7. 3	Patient leakage current N.C. reversed	µA
☐	2. 4. 7. 4	Patient leakage current S.F.C. reversed	µA
3		**Function and condition test**	
☐	3. 1	Input test	
☐	3. 2	Accompanying documents	
3. 3		**Anesthetic gas scavenging (AGS) system**	
☐	3. 3. 1	Condition of AGS	
☐	3. 3. 2	Function of AGS	
☐	3. 3. 3	Function of flow control in AGS USA variant	
3. 4		**Bronchial suction device (if fitted)**	
☐	3. 4. 1	Condition of bronchial suction device	
☐	3. 4. 2	Condition of secretion tank and accessories	
☐	3. 4. 3. 1	Performance test	
☐	3. 4. 3. 2	Static final pressure	
☐	3. 4. 3. 3	Function of non-return valve	
☐	3. 4. 3. 4	Function of vacuum switch	
☐	3. 4. 4. 1	Function of vacuum extraction	
☐	3. 4. 4. 2	Function of vacuum switch	
☐	3. 5	Function of auxiliary O2 flow meter next to test cone	
3. 6		**Breathing system**	
☐	3. 6. 1	Condition of breathing system housing	
☐	3. 6. 2	Mechanical safety valve (3.16)	hPa
☐	3. 6. 3	Pressure gauge (3.32)	hPa
☐	3. 7	UPS test	
3. 8		**High-pressure modification set (if fitted)**	
☐	3. 8. 1	Condition of high-pressure conversion kit	
☐	3. 8. 2	High-pressure regulator performance test	

☐	3. 8. 3 Downstream pressure test	
☐	3. 8. 4. 1 O2 opening pressure (if available)	bar
☐	3. 8. 4. 2 N2O opening pressure (if available)	bar
☐	3. 8. 4. 3 AIR opening pressure (if available)	bar
☐	3. 8. 5 High-pressure sensors reference pressure test	
☐	3. 9 External O2 flowmeter (if fitted)	
☐	3.10 Function of safety flow adjuster	
3.11	**Function of O2 flush**	
☐	3.11. 1 Mechanical functioning of O2 flush	
☐	3.12 Blower	
☐	3.13 DIVA metering module	
☐	3.14 Power supply unit	
☐	3.14. 1 Power failure alarm	
☐	3.15 Zeus power-on test	
3.16	**Hemodynamics monitoring (if fitted)**	
☐	3.16. 1. 1 ECG display	
☐	3.16. 1. 2 Interruption of an ECG electrode	
☐	3.16. 1. 3 Alarm function	

☐	3.16. 1. 4 Asystole	
☐	3.16. 2 SPO2	
☐	3.16. 3 Temperature	
☐	3.16. 3. 1 NIBP measurement check	
☐	3.16. 4. 1 Zero calibration of the sensors	
☐	3.16. 4. 2 Function test of the IBP pressure sensors	
3.17	**Gas measurement module Zeus (GMZ)**	
☐	3.17. 1 O2 measurement of the PGA (ServoMex)	
☐	3.17. 2 O2 measurement of the SGA (Oxytrace)	%O2
☐	3.17. 3 CO2 measurement of the PGA (ServoMex)	
☐	3.17. 4 Gas measurement function test	
3.18	**Ventilation modes**	
☐	3.18. 1 Manual ventilation	
☐	3.18. 2 Spontaneous breathing	
☐	3.18. 3 Pressure Mode	
☐	3.18. 4 Volume Mode (const. Flow)	
☐	3.18. 5. 1 Insp. O2	
☐	3.19 Unit handover	

Report:

Tested according to test specifications. Name/date/signature:

Dräger medical
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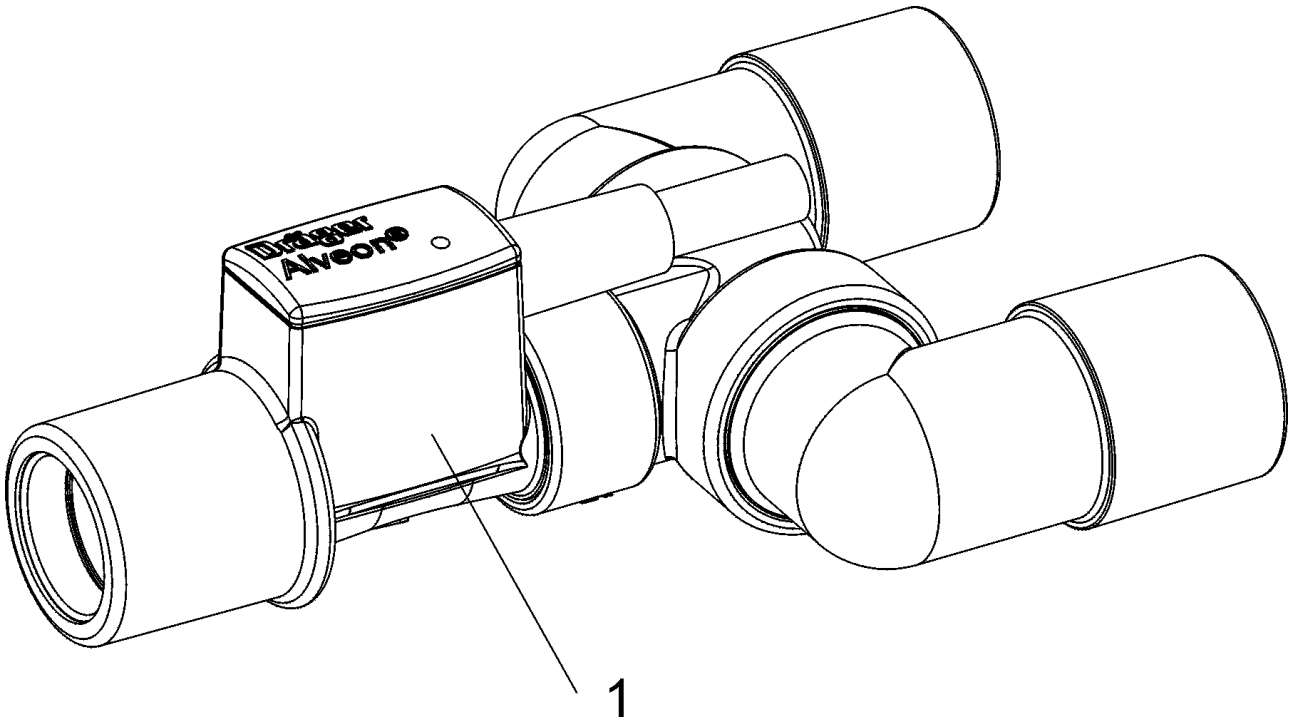
Parts catalog

Zeus

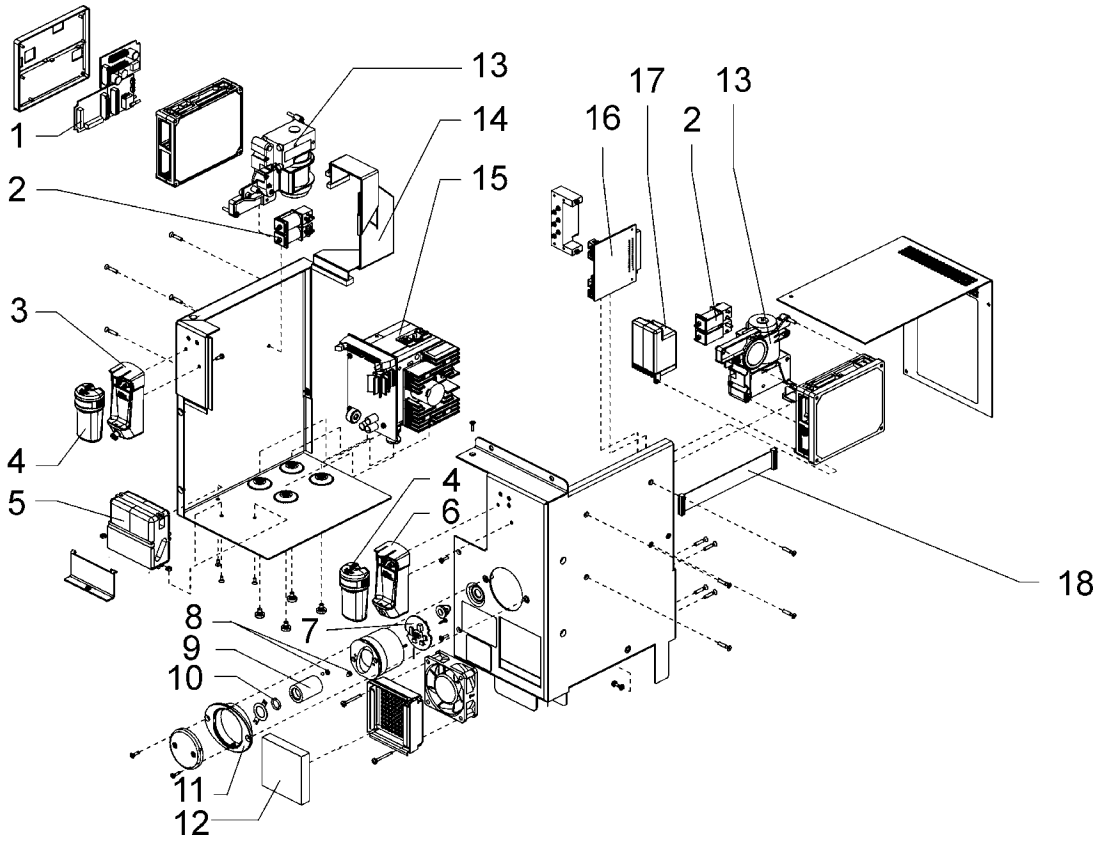
Revision: 2005-05

5133.001



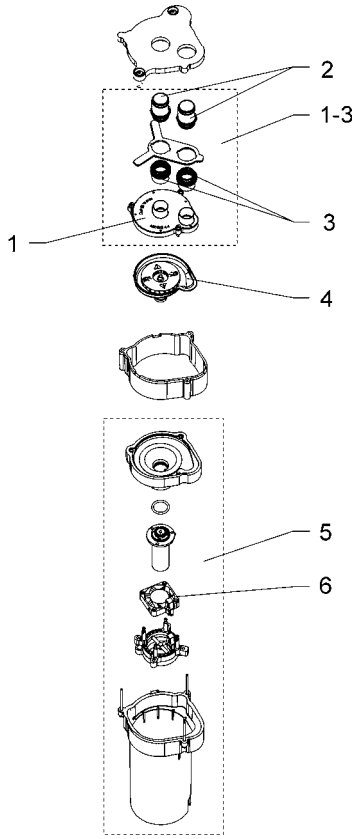
Item No.	Part No.	Description	Qty.	Qty. unit	Remark
1	MK01400	Alveon (with Luer Lock)	1.000	St	

Items that are shown in the illustration but are not listed below the illustration are not available as spare parts



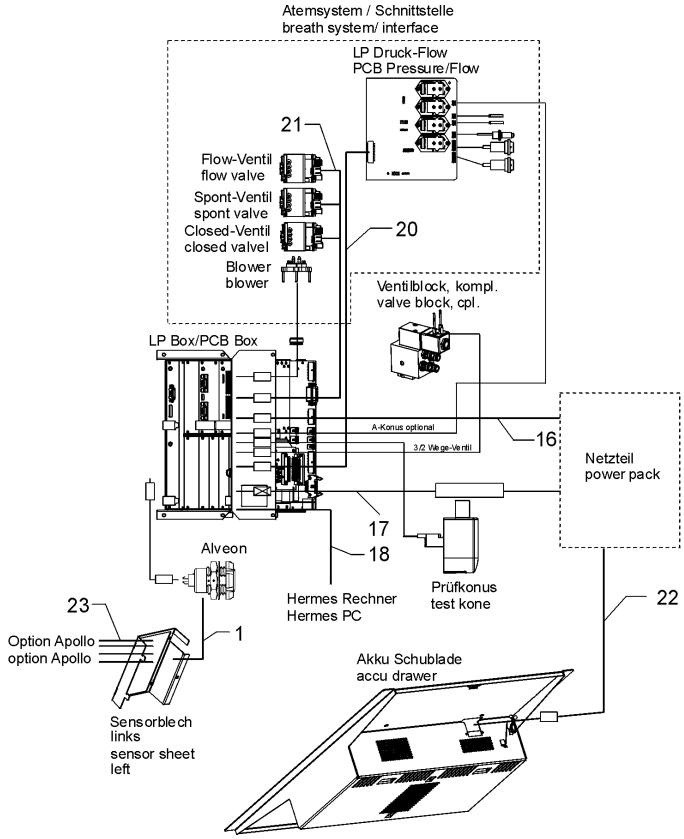
Item No.	Part No.	Description	Qty.	Qty. unit	Remark
4	6870511	WATER LOCK M	2.000	St	

Items that are shown in the illustration but are not listed below the illustration are not available as spare parts



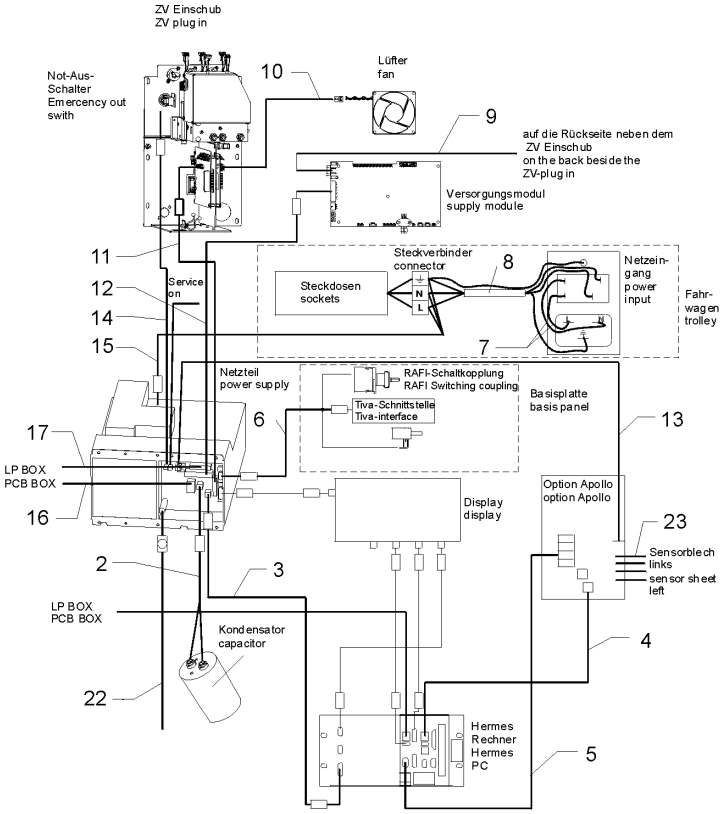
Item No.	Part No.	Description	Qty.	Qty. unit	Remark
1-6	MK01300	Ventilator	1.000	St	
4	MK00550	blower spindle	1.000	St	

Items that are shown in the illustration but are not listed below the illustration are not available as spare parts



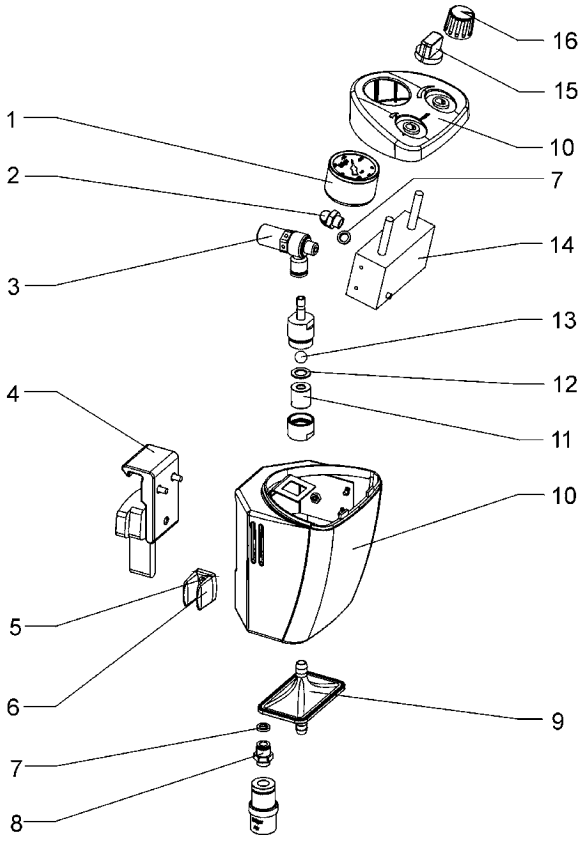
Item No.	Part No.	Description	Qty.	Qty. unit	Remark
18	1856014	Crossed Patch-cable 1m	1.000	St	

Items that are shown in the illustration but are not listed below the illustration are not available as spare parts



Item No.	Part No.	Description	Qty.	Qty. unit	Remark
8	MK02608	Power Cord	1.000	St	
15	MK02530	Power Cord	1.000	St	

Items that are shown in the illustration but are not listed below the illustration are not available as spare parts



Item No.	Part No.	Description	Qty.	Qty. unit	Remark
1-16	MK01420	Suction Ejector, NIST	1.000	St	
9	MK00514	FILTER	1.000	St	

Items that are shown in the illustration but are not listed below the illustration are not available as spare parts

Assembly	Description	Part No.
Accessories/consumables		
	ACCESS.SUCTION UNIT F.JULIAN	8601179
	Adap HEMO POD 10pin	3375958
	Adap HEMO POD Abbott	5196998
	Adap HEMO POD Baxter	5196980
	Adap HEMO POD Ohmeda	3375941
	Adap HEMO POD Sensonor 7pin	4329160
	Adap NBP Cuff	4530283
	Adap Pin Neo Electrode 10Pc	5194779
	AGSS ANGLE PROBE / TYPE 1 / EN	G60495
	AGSS PROBE/STRAIGHT-TYPE1/ EN	G60580
	AGS-SCAVANGER HOSE 1,5M	M33297
	AGS-SCAVANGER HOSE 3M	M33298
	AGS-SCAVANGER HOSE 5M	M33299
	AGS-SYSTEM, BASIC UNIT	M33300
	AGS-TRANSFER-HOSE 0,5M	M35016
	AIR CONNECTING HOSE 3M (BLACK)	M29241
	AIR-CONNECTING HOSE 5M (BLACK)	M29261
	AIR-ZV-HOSE 3M NIST EN-COLOR	8602520
	AIR-ZV-HOSE 5M NIST EN-COLOR	8602521
	Alveon (with Luer Lock)	MK01400
	ANAESTH.WASTE GAS PROBE 45	G60440
	ANAESTHETIC-MASK SZ,3	2165759
	ANAESTHETIC-MASK SZ.1	2165732
	ANAESTHETIC-MASK SZ.2	2165740
	ANGULAR PORCELAIN BUSH	M30159
	ASPIRATION HOSE	M25780
	Baby-Resutator 2000	2120941
	Bag 0,5L CR 5pcs set	MX50045
	Bag 1,0L CR 5pcs set	MX50046
	Bag 2,0L CR 5pcs set	MX50047
	Bag 3,0L CR 5pcs set	MX50048
	Block ECG 6-Lead ESU	7486140
	blower spindle	MK00550
	Blower Top	MK01244
	BREATH.HOSE 150CMLONG SLEEVE	2166046
	BREATH.HOSE 60CM LONG SLEEVE	2166011
	BREATH.HOSE LONG 110CM SLEEVE	2166038
	BREATHING HOSE E 110CM	2165635
	BREATHING HOSE E 150CM	2165643
	BREATHING HOSE E 35CM	2165619
	BREATHING HOSE E 60CM	2165627
	BREATHING HOSE K 22/10 0,6M	2165821
	BREATHING HOSE K 22/10 1,1M	2165651
	BREATHING HOSE K 22/10 1,5M	2165961

Assembly	Description	Part No.
	BREATHING HOSE K 22/22 0,6M	2165902
	BREATHING HOSE K 22/22 1,1M	2165678
	Cardiac Output T-Piece 25Pc.	5741975
	Cbl CO Intermediate 1m	3368458
	Cbl Connect POD 3m	3368425
	Cbl Connect POD 5m	5195198
	Cbl Connect Spectramed	4530291
	Cbl for Catheter S 4	8419160
	Cbl HEMOMED to Monitor 3m	5591925
	Cbl IBP Adap SC5/6000 10-7pin	3368383
	Cbl IBP Interm Ohmeda 3.0	3375933
	Cbl IBP Interm Sensonor 3.7m	4321563
	Cbl IBP Transducer Ext 3m	7486876
	Cbl Intermediate S 4	8419145
	Cbl POD Connection .3m	7257988
	Cbl SpO2 Sensor Ext 1m	3368433
	Cbl SpO2 Sensor ExtShielded 2m	3375834
	Cbl Temp Adap 1.5m	5196485
	Cbl Temp Adap 1.5m 4SI-INF	5198333
	Cbl w/ Injectate Feeler	8420077
	CHILDREN-MASK SILICONE SIZE 1	AB10048
	CHILDREN-MASK SILICONE SIZE 2	AB10049
	Child-Resutator 2000	2120984
	CO Cable Thermistor, Baxter	8539983
	Connect Hose Flexible NBP 3m	8836595
	Connect Hose NBP 2.4m	2870298
	Connect Hose NBP 3.7 m	1275275
	Cuff Adult NBP 23-33cm	2866643
	Cuff Adult NBP Large 31-40cm	2866650
	Cuff Adult NBP Small 17-25cm	2866635
	Cuff Cap Screw NBP	8837858
	Cuff Child NBP 12-19cm	2866676
	Cuff Neonatal NBP 1 10Pc	2870181
	Cuff Neonatal NBP 2 10Pc	2870199
	Cuff Neonatal NBP 3 10Pc	2870207
	Cuff Neonatal NBP 4 10Pc	2870215
	Cuff Neonatal NBP 5 10Pc	2870173
	Cuff Thigh NBP 38-50cm	2866668
	Delivery module D	MK01704
	Delivery module I	MK01702
	Delivery module S	MK01703
	DoubleBlue Big,ST	MX02640
	DoubleBlue L,ST	MX02642
	DoubleBlue,ST	MX02641
	DRAEGERSORB 800 PLUS (5L)	MX00001
	Draegersorb FREE (5L)	MX50050

Assembly	Description	Part No.
	Durasensor SpO2 DS100A Adult	7262764
	EARTHING CABLE, 0,8 M	8301348
	EARTHING CABLE, 3,2 M	8301349
	ECG 3-Lead Snap-On Holder	3375420
	ECG 5-Lead ESU Block	5947226
	ECG 5-Lead Snap-On Holder	3375438
	ECG Electrode Disp 50Pc.	4527750
	ECG Electrode Neonatal 300Pc.	5195024
	FILTER	MK00514
	Grabber 3-Lead ECG IEC1	5956433
	Grabber 5 Lead IEC1	5956466
	Grabber 6 Lead IEC1	5956482
	HEMO2 POD	4319435
	HEMO4 POD	4315961
	HEMO4 Trans plate, Abbt TP IV	7270460
	HEMO4 Transd Plate Abt/Brn	5192112
	HEMO4 Transd Plate Med/Sen	4721416
	HEMO4 Transd Plate Univrsl 5pc	4721424
	HEMOMED POD	5588822
	Holder NEOMED	5598128
	HOOK	M26349
	HOSE 5X2SI 60SHA NF M25779	1203606
	Hose NIST Air 0,5m	MK02751
	Hose NIST N2O 0,5m	MK02752
	Hose NIST O2 0,5m	MK02753
	IBF Zeus	MK02588
	Keyed filler adapter I	M30290
	Kit IBP Disposable 10Pc	7489433
	Medisize Hygrovent Child	MX02645
	Mounting Set Capto 840	7267151
	N2O-CONNECT.HOSE 3M (BLACK)	M29237
	N2O-CONNECT.HOSE 5M (BLACK)	M29257
	N2O-ZV-HOSE 3M NIST EN-COLOR	8602517
	N2O-ZV-HOSE 5M NIST EN-COLOR	8602518
	NOZZLE 22/22	M25647
	O2-CONNECT.HOSE 3M (BLACK)	M29233
	O2-CONNECT.HOSE 5M (BLACK)	M29253
	O2-ZV-HOSE 5M NIST EN-COLOR	8602515
	O2-ZV-HOSE3M NIST EN-COLOR	8602514
	Oxidem 3000	2M86296
	Oxisensor SpO2 D20 Ped 24Pc CE	7490258
	Oxisensor SpO2 D25 Adt 24Pc CE	7490241
	Oxisensor SpO2 I20 Inft24Pc CE	7490266
	Oxisensor SpO2 N25 Neo 24Pc CE	7490274
	Plate HEMO2 Transd Med/Ssn	4721614
	Plate HEMO2 Transd Ohmeda	4721408

Assembly	Description	Part No.
	POD MULTIMED 5 1.5m	5950196
	POD MULTIMED 5 2.5m	3368391
	POD MULTIMED 6 2.5m	5191221
	POD NEOMED 2.5m	5590539
	Press Dome F.Sensor 840 50Pc.	4529954
	Press.Red.Air,BS341-1,Zeus	8603717
	Press.Red.Air,DIN477-1,Zeus	8603511
	Press.Red.Air,NF E29-650,Zeus	8603715
	Press.Red.Air,PIN INDEX,Zeus	8603510
	Press.Red.N2o,DIN477-1/12,Zeus	8603505
	Press.Red.N2o,NF E29-650,Zeus	8603506
	Press.Red.N2o,PIN INDEX,Zeus	8603502
	Press.Red.o2,BS341-1,Zeus	8603494
	Press.Red.o2,DIN477-1,Zeus	8603472
	Press.Red.o2,DIN477-1/6,Zeus	8603491
	Press.Red.o2,NF E29650,Zeus	8603492
	Press.Red.o2,PIN INDEX,Zeus	8603468
	Pressure Transducer Disposable	4528741
	RECEPTACLE	2M85594
	Resutator 2000 adults	2120046
	RS Air Connection	8603255
	RS Holder extern Flowtube	8604116
	RS o2 Connection	8603253
	Sample Line Set (10pcs)	8290286
	SECRETION CONTROL GLASS	M07582
	SecuRed Big, ST	MX02650
	SecuRed L, ST	MX02652
	SecuRed, ST	MX02651
	Sensor Flow Dspl 840 10Pc.	4530226
	Set Cylinder Zeus	MK02274
	SET MIC.FILTER 654ST-ISOCLICK	6733895
	Set of 5 Spirolog sensors	8403735
	SpiroLife	MK01900
	Suction Ejector, NIST	MK01420
	Temp Probe Adult 1.5m	4329889
	Temp Probe Adult 3m	5201327
	Temp Probe Adult 3m	5204644
	Temp Probe Adult 5m	5201319
	Temp Probe Covers 10Pc.	7014616
	Temp Probe Pediatric 1.5m	4329848
	Temp Probe Pediatric 3m	5201343
	Temp Probe Pediatric 3m	5204651
	Temp Probe Skin 1.5m	4329822
	Temp Probe Skin 3m	5201335
	Temp Probe Skin 3m Inf	5204669
	Transducer IBP Memscap 844	7489417

Assembly	Description	Part No.
	VACUSMART 700ML	MX23023
	VACUSMART TUBE (2M)	MX23026
	Ventilator	MK01300
	Water trap	8404985
	WATERTRAPS SET OF 12	6870567
	Y-Adap IBP 16 To 2x7 Pin	5592147
	Y-Cbl IBP 16-10Pin SC7/9000X	5731281
	Y-Cbl IBP Abb/Med-SC6002 3.7m	5206573
	Y-Cbl IBP Adap 10-7pin	5588095
	Y-Cbl IBP Interm Baxter 3.7m	5206607
	Y-Cbl IBP Interm Sensonor 3.7m	5195180
	Y-Cbl IBPIntermOhm-SC6002 3.7m	5206581
	Y-Cbl Temp 2 X 7 Pin	5592154
	Y-PIECE 90DEGREE	8403075
	Y-PIECE STRAIGHT PAED	M27077
Alveon		
	Alveon (with Luer Lock)	MK01400
Blower		
	blower spindle	MK00550
	Ventilator	MK01300
Breathing system		
	Breathing System	MK02210
	IBF Zeus	MK02588
	SpiroLife	MK01900
Ejector type aspirat. NIST Air		
	FILTER	MK00514
	Suction Ejector, NIST	MK01420
Gas measuring module Zeus		
	WATER LOCK M	6870511
Gas supply block		
	COPPER RING	D04873
	CUFF	AF00220
	Pressure regulator	8413666
	PRESSURE SENSOR	8602767
	SCREW PLUG	D18348
	TOROIDAL SEALING RING	M19241
Maintanance parts		
	FILTER	MK00514
	WATER LOCK M	6870511

Assembly	Description	Part No.
Manuals/Techn. Documentation		
	GA ZEUS DE	9037807
	GA Zeus SW 3.n de	9038191
	GA Zeus SW 3.n en	9038192
	GA Zeus SW 3.n es	9038194
	GA Zeus SW 3.n fr	9038193
	GA Zeus SW 3.n it	9038195
	GA Zeus SW 3.n nl	9038196
	TD Zeus de	9036189
	TD Zeus en	9036190
	ZEUS GA enGB	9037987
	ZEUS GA fr	9037988
	ZEUS GA nl	9037989
Modification kits / options		
	Container for Catheters	MK03158
	Kit SW 3.00, Zeus	MK03718
	Option Apollo	MK02017
Products concerned		
	Zeus	MK03000
Wiring		
	Crossed Patch-cable 1m	1856014
	DSub-Port Saver TIVA	MK02966
	Power Cord	MK02608
	Power Cord	MK02530

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